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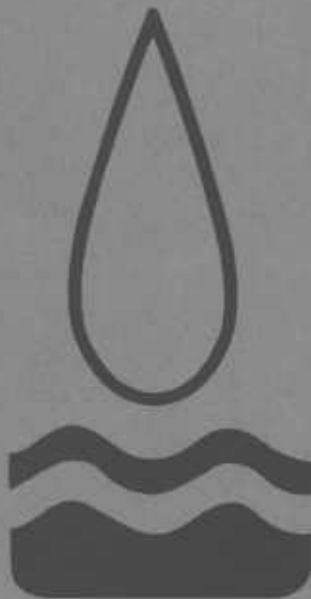
Agriculture
Handbook 296

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Land Resource Regions and Major Land Resource Areas of The United States

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Land Resource Regions and Major Land Resource Areas of The United States

United States Department of Agriculture
Soil Conservation Service
Washington, D.C.

Agriculture Handbook 296
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INTRODUCTION

This handbook is an assemblage of currently available information about the land as a resource for farming, ranching, forestry, engineering, recreation, and other uses. It is a revision of USDA Agriculture Handbook No. 296, Land Resource Regions and Major Land Resource Areas of the United States, published in 1965. Revisions consist of: (1) Refined delineations of land resource regions (LRR's) and major land resource areas (MLRA's), (2) identification of the soils of each region and area according to the system of Soil Taxonomy, (1975), (3) a brief discussion concerning the potential natural vegetation of the resource regions and areas, and (4) inclusion of major land resource areas and land resource regions for the states of Alaska and Hawaii and the territory of Puerto Rico (Appendix III). Information is current as of April 1978.

The information in this handbook affords a basis for making decisions about national and regional agricultural concerns, identifies needs for research and resource inventories, provides a broad base for extrapolating the results of research within national boundaries, and serves as a framework for organizing and operating resource conservation programs.

The land resource categories used at state and national levels are land resource units, land resource areas, and land resource regions.

Land resource units are geographic areas, usually several thousand acres in extent, that are characterized by a particular pattern of soils, climate, water resources, and land uses. A unit can be one continuous area or several separate nearby areas.

Land resource units are the basic units from which major land resource areas are determined. They are also the basic units for state land resource maps. They are coextensive with state general soil map units, but some general soil map units are subdivided into land resource units because of significant geographic differences in climate, water resources, and land use. Land resource units are not described in this handbook, and they are not shown on the national map.

Major land resource areas (MLRA's) are geographically associated land resource units. Identification of these large areas is important in statewide agricultural planning and has value in interstate, regional, and national planning.

In this handbook major land resource areas are designated by Arabic numbers and identified by a descriptive geographic name. For example, MLRA 1 (Northern Pacific Coast Range, Foothills, and Valleys) is on the west coast; MLRA 157 is on the east coast; and MLRA 175 (Kuskokwim Highland) is in Alaska.

Some major land resource areas are designated by an Arabic number and a letter because previously estab-

lished major land resource areas have been divided into smaller, more homogeneous areas. The use of numbers and letters to identify the newly created major land resource areas requires fewer changes in existing information in records and in data bases. A few major land resource areas consist of two or more parts separated for short distances by other land resource areas. In places one of these parts is widely separated from the main body of the major land resource area and is in an adjoining land resource region. The description of the respective major land resource area also applies to these outlying parts.

Land resource regions are designated by capital letters identified by a descriptive name. For example, the descriptive name for Land Resource Region A is the Northwestern Forest, Forage, and Specialty Crop Region.

The dominant physical characteristics of the land resource regions and of the 204 major land resource areas are described briefly under the headings land use, elevation and topography, climate, water, soils, and potential natural vegetation. The state or states in which an MLRA occurs and the extent of the MLRA are indicated on the first page of each description. The area and proportionate extent of the regions and the MLRA's are given in appendix I.

Land use.—The relative extent of the federally or privately owned land is indicated if significant. The extent of the land used for cropland, pasture, range, forests, industrial and urban developments, and other special purposes is indicated. These fractions or percentages are for the entire resource area unless specifically stated otherwise. Also included is a list of the principal crops grown and the type of farming practiced.

Elevation and topography.—A range in height above sea level and significant exceptions, if applicable, are provided for the area as a whole. The topography of the area, including natural and cultural features, is described.

Climate.—Climatic data discussed are: (1) A range of the annual precipitation for the driest parts of the area to the wettest and the seasonal distribution of precipitation and (2) a range of the average annual temperature and the average freeze-free period characteristic of different parts of the resource area.

Water.—Information is provided concerning surface streamflow and ground water and the source of water for municipal use and for irrigation. Also, land resource areas dependent on other areas for water supply and those that furnish water to other areas are specified.

Soils.—The dominant soils of the major land resource area are identified according to the principal suborders, great groups, and representative soil series.

General descriptions of the soil orders, suborders, and great groups are provided in appendix II.

Potential natural vegetation.—The plant species that the major land resource area can support are identified by their common names.

The descriptions are based on information from many

sources, mainly from the Soil Conservation Service, U.S. Department of Agriculture. Most information about land use is based on recent reports of state soil and water conservation needs. For additional sources, refer to the list of references.

A—NORTHWESTERN FOREST, FORAGE, AND SPECIALTY CROP REGION

204,080 km² (78,790 mi²)

Steep mountains and narrow to broad, gently sloping valleys and plains characterize this region. The average annual precipitation ranges from 1,025 to 1,775 mm in much of the region, but it is 375 mm or less in some valleys and as much as 5,075 mm in some of the higher mountains. All this region is dry during the summer. The average annual temperature is 10 to 13°C in most of the region, but it is 2°C or less in some of the mountains. The freeze-free period is more than 200 days in most valleys, as long as 300 days along the coast in the southern part, and less than 115 days in the mountains.

Umbrepts, Ochrepts, Humults, Xerults, Andepts, and Orthents are the principal soils in the mountains and on uplands. Fluvents, Xerolls, Xeralfs, Aquolls, and Aquepts are extensive in the valleys.

The mountains are heavily forested, and lumbering is a major industry. Dairy farming is an important enterprise in the valleys that have abundant rainfall. Grain crops, grass and legume seeds, fruits, and horticultural specialties are grown extensively in the drier valleys.

1—Northern Pacific Coast Range, Foothills, and Valleys

Oregon and Washington

41,020 km² (15,840 mi²)

Land use: About 90 percent of this area is privately owned. The area is densely forested, and lumbering is the chief industry. About 9 percent is cleared and used for general agriculture. The cleared areas are mainly in the narrow valleys and on coastal terraces. Hay, pasture, and some grain for cattle are the principal crops. About 1 percent of this area, mainly land bordering water, is used for urban development. Recreation and wildlife habitat are other important land uses.

Elevation and topography: Elevation ranges from sea level to about 900 m, but the average is about 200 m. Most of this area consists of low coastal terraces, hills, and low mountains with gentle to steep slopes. Valleys are mostly narrow and of small extent. Most of the nearly level bottom land on the coast is susceptible to tidal influence.

Climate: *Average annual precipitation*—1,400 to 3,175 mm. Precipitation is evenly distributed throughout fall, winter, and spring. Summers are dry. In most of this area, snow falls only a few days each year. *Average annual temperature*—7 to 13°C. *Average freeze-free period*—60 to 270 days, decreasing with elevation.

Water: Precipitation, perennial streams, and lakes provide abundant water for all present requirements. Glacial and alluvial deposits in the valleys yield large quantities of ground water.

Soils: Most of the soils are Umbrepts or Ochrepts. They are well drained and gently sloping to very steep and have a mesic temperature regime and a mixed mineralogy. Haplumbrepts (Astoria, Hembre, Lytell, Boistfort, and Solleks series) formed in volcanic ash and in material weathered from siltstone, sandstone, and basic igneous rock. Dystrochrepts (Calawah, Hoquiam, Kalalock, and Klone series) and Duro-

chrepts (Dabob and Hoko series) formed in glacial drift. The nearly level Udifluvents (Belfast, Grehalem, and Hoh series) formed on flood plains.

Potential natural vegetation: This area supports forest vegetation. The coniferous forest stands are dense, tall, and highly productive. Western hemlock, western redcedar, Douglas-fir, and Sitka spruce are common, and grand fir grows in places. Red alder is aggressive on disturbed sites. Lodgepole pine is common along the coastal dunes. Mature forests have lush understories with dense growths of shrubs, herbs, ferns, and cryptograms. Tree species in the southern part of the region include Port-Orford-cedar, California bay, madrone, tanoak, and golden chinkapin. Salmonberry, ladyfern, swordfern, rhododendron, Pacific waxmyrtle, willow, vine maple, evergreen huckleberry, salal, oxalis, and violet are major shrubs and forbs.

2—Willamette and Puget Sound Valleys

Oregon and Washington

48,160 km² (18,590 mi²)

Land use: Much of this area is privately owned; about one-sixth is federally owned. Nearly three-fourths of the land in Puget Sound Valley is forested, and lumbering is the major industry. In Willamette Valley only three-fifths or less is forested, and lumbering is not so important. Urbanization is increasing in much of the area. Less than one-fifth of the total MLRA is in crops or improved pasture, but agriculture is highly diversified. Deciduous fruits, berries, vegetables, seed crops, and grains grown under intensive management are the major crops. A large acreage is also used for growing hay and grain for dairy and poultry feed. High-value crops are grown under irrigation in some places, but rainfall is the source of water for most crops.

Elevation and topography: Elevation ranges from sea level to 500 m. Willamette Valley consists of

nearly level to gently sloping flood plains bordered by dissected higher terraces. Glacial till, glacial outwash, and lacustrine deposits cover Puget Sound Valley.

Climate: *Average annual precipitation*—Ranges from 375 to 2,550 mm, but it is 750 to 1,150 mm in much of the area. Precipitation is evenly distributed throughout fall, winter, and spring, but summers are dry. *Average annual temperature*—9 to 13°C. *Average freeze-free period*—120 to 240 days.

Water: Moderate precipitation and abundant streamflow provide enough water for present needs. Additional supplies are available from adjoining mountain ranges. Ground water is plentiful in glacial and alluvial deposits.

Soils: Most of the soils are Xerolls. These soils are moderately deep to deep and moderately fine textured to fine textured and have a mesic temperature regime and a mixed mineralogy. The nearly level, well drained Haploxerolls (Chehalis and Puyallup series) and the nearly level, moderately well drained Argixerolls (Woodburn series) are on flood plains and terraces. Poorly drained Albaqualfs (Dayton series) formed in clayey alluvium on terraces. Poorly drained Haplaquepts (Bellingham series) formed in glacial till on uplands of the Puget Sound Valley. The sloping to steep, well drained Haplohumults (Jory, Olympic, and Bellpine series) and Haploxeralfs (Melbourne series) are on uplands. The moderately steep to steep, well drained Durochrepts (Alderwood series) are on glacial till uplands.

Potential natural vegetation: This area supports forest vegetation in many places, prairie vegetation in some places, and savanna vegetation in others. Douglas-fir is the dominant tree species. Bigleaf maple, western redcedar, grand fir, and western hemlock are also common. Red alder is aggressive on disturbed sites in Washington. Stands of cottonwoods and willows grow on overflow channels, streambanks, and islands. Oregon white oak is common in savannas, especially in Oregon. Red and western fescues, bromes, and sedges are common in the prairies and savannas. Forest and savanna understory species include tall Oregon-grape, Indian plum, snowberry, hazel, oceanspray, serviceberry, rose, poison-oak, swordfern, dwarf Oregon-grape, salal, vine maple, red huckleberry, thimbleberry, and oxalis.

3—Olympic and Cascade Mountains

Oregon and Washington
65,310 km² (25,210 mi²)

Land use: About 95 percent of this area is federally or state owned. Most of the area is densely forested, and lumbering is the major industry. At high elevations, alpine meadows provide summer range. Mining is important in some places. Recreation and wildlife habitat are also important land uses.

Elevation and topography: Elevation generally ranges

from 200 to 1,700 m, but on mountain peaks it is as high as 4,400 m. Steep mountains, narrow valleys, some U-shaped glaciated valleys, and narrow divides are dominant. There are some plateaus. Narrow bands of bottom land and terraces border some of the streams.

Climate: *Average annual precipitation*—1,525 to 2,550 mm in most parts but more than 2,550 mm on the more elevated parts and as much as 6,100 mm on Mt. Olympus. Maximum precipitation is in fall, in winter, and in spring; all the area receives snow in winter. *Average annual temperature*—2 to 10°C, decreasing with elevation. *Average freeze-free period*—0 to 200 days, decreasing with elevation. Some high mountain peaks receive frost every month of the year.

Water: Precipitation and perennial streams fed by glaciers and springs provide abundant water for all present needs. This area supplies water to adjoining MLRA's at lower elevations that receive less precipitation.

Soils: Most of the soils are Ochrepts, Andepts, Boralfs, and Orthods. They are well drained and gently sloping to very steep and have a mesic, frigid, or cryic temperature regime. Xerochrepts (Barneston and Skykomish series) formed in glacial outwash materials. Vitrandepts (Cispus series), Dystrandepts (Cinebar, Zynbar, and Larchmount series), and Cryandepts formed in materials that have a high content of volcanic ash. Glossoboralfs (Wilkeson series) formed in materials weathered from andesite and basalt. Haplorthods (Klaus series) formed in glacial drift. Cryorthods and Cryochrepts (Oso series) formed in glacial drift and volcanic debris.

Potential natural vegetation: This area supports dense forest stands. Douglas-fir, Pacific silver fir, and western hemlock are typical species. Western redcedar, noble fir, and western white pine are common. At higher elevations, mountain hemlock is an important part of the plant community, and subalpine fir and whitebark pine grow near timberlines. Huckleberry, salal, blackberry, twinflower, vine maple, Pacific yew, thimbleberry, violet, trillium, swordfern, insideout flower, oxalis, beargrass, and false-azalea are common in the understory.

4—California Coastal Redwood Belt

California
13,880 km² (5,360 mi²)

Land use: Most of this area consists of privately owned farms, ranches, or forests; about 10 percent is federally owned. About 68 percent of the area is densely forested, and lumbering is the major industry. About 10 percent is grassland used for grazing. Cultivated land in the valleys and along the coast, making up about 3 percent of the area, is used mainly for growing forage and grain for dairy cattle. Vegetables and fruits (apples) are grown in places where

the soils and the climate are favorable. Soils in basins and on flood plains are susceptible to flooding, deposition of sediments, and local streambank cutting. The hazard of erosion is moderate on soils on terraces and coastal benches. If the grass cover on soils on uplands is removed by logging, fire, overgrazing, or cultivation, the hazard of erosion is severe.

Elevation and topography: Elevation is from sea level to 800 m, but on some peaks it is 1,200 m. Low but steeply sloping mountains are dominant. Gently sloping marine terraces border the coast, and a few broad valleys extend inland through the mountains.

Climate: *Average annual precipitation*—825 to 2,025 mm. Precipitation is evenly distributed throughout fall, winter, and spring, but it is low in summer. Heavy fogs are common along the coast in summer. *Average annual temperature*—10 to 13°C. *Average freeze-free period*—250 to 300 days.

Water: Abundant precipitation and many perennial streams provide enough water for most requirements. The drier valleys depend on streamflow from the mountains. Ground water is abundant in the deeper valley-fill deposits.

Soils: The dominant soils are Xerults, Xerolls, Ochrepts, and Humults. They have a mesic temperature regime, but some in the coastal zone have an isomesic temperature regime. Soils on uplands are Haploxerults (Goldridge and Josephine series), Xerochrepts (Hugo and Maymen series), Haplohumults (Sites series), Haploxerolls (Laughlin, Kneeland, and Ben Lomond series), Argixerolls (Yorkville series), and Hapludalfs (Atwell series). Soils on terraces and coastal benches are Argialbolls (Watsonville series), Tropohumults (Empire and Rohnerville series), and Tropudults (Caspar series). Soils in basins and on flood plains are Fluvaquents (Bayside series), Tropofluvents (Ferndale series), and Haploxerolls (Soquel series).

Potential natural vegetation: This area supports forest and grass vegetation. Redwood, Douglas-fir, grand fir, bishop pine, western redcedar, Port-Orford-cedar, alder, California bay, chinkapin, madrone, tanoak, and California black oak are dominant tree species. California oatgrass, tufted hairgrass, western and Idaho fescues, Pacific reedgrass, and native and introduced bentgrasses are common perennial grasses. Soft chess, wild oats, bromes, filaree, and burclover are important naturalized annuals. Gorse-broom and Scotch-broom are dominant in some parts of the coastal zone.

5—Siskiyou-Trinity Area

California and Oregon
35,710 km² (13,790 mi²)

Land use: Nearly half of this area is federally owned.

Most of the land is in conifer forests that are important for lumbering, wildlife habitat, and recreation. About 10 percent of the area is grazed, and a smaller acreage is cropped. Livestock is the principal farm enterprise. Truck crops are important in valleys where the water is adequate. On the more sloping parts of the valleys, small grains, hay, and pasture are grown as feed for dairy cattle and other livestock. The erosion hazard is high because of steep slopes, erodible soils, and high rainfall. The erosion hazard is severe if the plant cover is removed. Mass movement in the form of landslides is a serious problem and a major source of sediment in the rivers.

Elevation and topography: Elevation ranges from 100 to 1,400 m, but on some mountain peaks it is 2,700 m. Rounded but steeply sloping mountains that are underlain mainly by sandstone and shale but in some places by granodiorite, gabbro, and other intrusive rocks are dominant. The narrow valleys have gently sloping flood plains and alluvial fans and are bordered by strongly sloping foothills.

Climate: *Average annual precipitation*—450 mm in some valleys to 2,150 mm in the mountains. Precipitation is low in summer but is evenly distributed throughout the rest of the year. *Average annual temperature*—7 to 13°C. *Average freeze-free period*—60 to 250 days, decreasing with elevation.

Water: The moderate to high precipitation provides enough water in the mountains and higher valleys and, through streamflow, supplies irrigation water in the drier valleys. Ground water is abundant in alluvial deposits in most valleys.

Soils: The dominant soils are Ochrepts, Xerults, Orthents, Xeralfs, and Umbrepts. They have a mesic temperature regime and a xeric moisture regime. Principal soils of the mountains are Xerochrepts (Sheetiron and Hugo series), Haploxerults (Josephine series), shallow Xerorthents and Xerochrepts (Etsel and Maymen series), Haploxeralfs (Holland and Dubakella series), and Xerumbrepts (Masterson series). Xerorthents and Xerofluvents are on flood plains and alluvial fans. Detailed soil survey information is lacking for much of the area.

Potential natural vegetation: This area supports forest, open forest, and prairie vegetation. Douglas-fir, ponderosa pine, sugar pine, incense-cedar, white fir, red fir, tanoak, Oregon white oak, California black oak, canyon live oak, and madrone are the dominant tree species. Poison-oak, snowberry, ceanothus, manzanita, rose, and whipplea characterize the forest understory. Blue wildrye, fescues, bluegrass, mountain brome, and some browse species are in the understory in open stands of timber. Soft chess, wild oats, burclover, fescues, and bromes are major prairie species.

B—NORTHWESTERN WHEAT AND RANGE REGION

239,650 km² (92,530 mi²)

This region of smooth to deeply dissected plains and plateaus also has a few mountain ranges. The average annual precipitation ranges from 250 to 575 mm in most of the region, but it is as low as 150 mm in some valleys and as much as 1,525 mm or more in some mountains. Summers are dry. The average temperature is 7 to 10°C in most of the region but ranges from 3 to 13°C. The freeze-free period ranges from 120 to 200 days, but it is shorter in the mountains.

Xerolls, Borolls, and Ochrepts, derived mainly from loess, are dominant in most of the region. Andepts formed in materials consisting mostly of volcanic ash. Orthents occur on steep slopes underlain by basalt and lava. Fluvents on flood plains are important for agriculture.

Wheat grown by dryfarming methods is the major crop in most of the region, but oats and peas are also important. Fruits, mainly apples, are a major crop in the west. Potatoes, sugar beets, beans, and forage crops are grown under irrigation along the Snake River in the eastern part of the region. Grazing is the major land use in the drier parts, especially in the west.

6—Cascade Mountains, Eastern Slope

Oregon and Washington

37,750 km² (14,570 mi²)

Land use: About 60 percent of this area is federally owned; most of the remainder is in farms, ranches, or privately owned woodland. About 75 percent is forested. Lumbering is an important industry. Much of the woodland is grazed by cattle. This area is also important for recreation and for wildlife habitat. Less than 5 percent, mostly in the valleys, is cropland, most of which is irrigated. Crops include tree fruits, small grains, and forage crops.

Elevation and topography: Elevation ranges from 300 to 2,400 m, but some mountain crests are 3,000 m. Strongly sloping mountains and U-shaped glaciated valleys are dominant. Some gently sloping crests and benches are dissected by many streams.

Climate: *Average annual precipitation*—500 to 1,775 mm, generally increasing with elevation, but on some mountain crests it is 2,550. *Precipitation falls mainly during the winter, spring, and fall; summers are relatively dry. All areas receive snow in winter. Average annual temperature*—4 to 10°C, but it is lower on mountain crests. *Average freeze-free period*—60 to 120 days, decreasing with elevation.

Water: Precipitation and perennial streams provide ample water. This area supplies water from the perennial streams and reservoirs to drier and lower lying MLRA's. Ground-water supplies are mostly untapped.

Soils: The dominant soils are Orthods, Andepts, Ochrepts, Xerolls, and Xerals. They have a mesic, frigid, or cryic temperature regime. Cryorthods and Haplorthods formed in residuum from weathered bedrock, alpine glacial till, and volcanic debris. Cryandepts (Surgh series) and Vitrandepts (Choralmont, Molson, and Palmich series) formed in recent and weathered volcanic ash. Shallow to deep Xero-

chrepts (Ardenvoir, Kartar, and Nevine series) formed in bedrock residue, glacial drift, and a mixed mantle of volcanic debris. Deep Haploxerolls (Conconully series) formed in glacial till. Haploxerals (Cle Elum and Varelum series) formed in material weathered from sandstone. Detailed soil survey information is lacking for most of the area.

Potential natural vegetation: This area supports conifer forest and grass vegetation. The kind of vegetation gradually changes with increases in elevation and in precipitation. Important species in grasslands at the lowest elevations are bluebunch wheatgrass, Sandberg bluegrass, big sagebrush, bitterbrush, Idaho fescue, and Cusick bluegrass. Ponderosa pine forest has an understory of bluebunch wheatgrass and Idaho fescue. Douglas-fir forest has an understory of pinegrass, bearberry, and currant. Grand fir, western larch, and lodgepole pine have an understory of vacciniums and menziesia. Pacific silver fir, mountain hemlock, subalpine fir, and whitebark pine are at the highest elevations.

7—Columbia Basin

Oregon and Washington

18,520 km² (7,150 mi²)

Land use: About 85 percent of this area is privately owned, and about 15 percent is federally owned or is set aside as Indian reservations. About 60 percent is range of native grasses and shrubs grazed by cattle. About 22 percent is dry-farmed. A wheat-fallow crop sequence generally is practiced. About 15 percent of the area is irrigated, and fruits, vegetables, sugar beets, hops, grain, hay, and pasture are grown under intensive management. There is a rapid increase in the use of sprinkler irrigation. About 3 percent of the area is urban.

Elevation and topography: Elevation ranges from 100 to 800 m, but most of the area is 200 to 500 m above sea level. In general, the area is a smooth,

gently sloping plain broken by some steep basalt ridges. The smooth plains are also dissected into large areas by drainageways.

Climate: *Average annual precipitation*—150 to 300 mm, increasing with elevation. Maximum precipitation is in winter; summers are dry. *Average annual temperature*—8 to 13°C. *Average freeze-free period*—120 to 200 days.

Water: The Columbia, Yakima, and Snake Rivers supply large quantities of water for irrigation. Most of the irrigation water is diverted from the natural river channel or is pumped to a higher elevation and delivered to individual farms by gravity flow. Water is scarce in all nonirrigated areas. Although ground-water supplies have increased since irrigation has been practiced in the area, they are largely untapped.

Soils: Most of the soils are Orthids, Orthents, Psamments, and Aquolls. They have a mesic temperature regime. Camborthids (Shano, Warden, and Ephrata series) formed in loess or in a mixed loess mantle over lacustrine or outwash deposits. Durorthids (Burke, Koehler, and Taunton series) formed in a silty loess or sandy eolian mantle over a lime-silica-cemented duripan. Somewhat poorly drained, very strongly alkaline Torriorthents (Umapine series) formed in alluvium. Torripsamments (Quincy and Winchester series) formed mostly in eolian sand. Somewhat poorly drained, nearly level Haplaquolls (Pasco, Toppenish, and Track series) formed on alluvial bottom lands.

Potential natural vegetation: This area supports shrub-grass associations. Big sagebrush and bluebunch wheatgrass are dominant on the medium textured soils. Bitterbrush and needleandthread are abundant on the sandy soils. Very shallow soils support stiff sagebrush and Sandberg bluegrass. Inland saltgrass, basin wildrye, and greasewood grow on saline-alkali soils.

8—Columbia Plateau

Oregon and Washington

42,730 km² (16,500 mi²)

Land use: More than 90 percent of this area is in farms or ranches; about 7 percent is federally owned, and the remainder is urban. Nearly one-half is cropland, most of which is dry-farmed. The main crops are wheat and peas, but a small acreage is in hay and improved pasture. In places where the annual precipitation is less than about 350 mm, a cropping system of alternate grain and summer fallow is practiced. Cropping systems of alternate grain and field peas, continuous grain crops, or variations, including rotations with grasses and legumes, are practiced in places where precipitation is greater than 350 mm. Small acreages along the major streams are irrigated and used for growing vegetables, fruits (mainly apples),

and hay. Nearly all the remaining land, about two-fifths of the total area, is in range, but small sections are wooded.

Elevation and topography: Elevation ranges from 400 to 1,100 m. These loess- and ash-mantled plateaus are nearly level to steeply sloping. Steep slopes are common along the walls of major valleys and in scablands.

Climate: *Average annual precipitation*—225 to 450 mm. Maximum precipitation is in winter. *Average annual temperature*—7 to 13°C. *Average freeze-free period*—140 to 175 days.

Water: The low to moderate precipitation limits the choice of agricultural enterprise. The major rivers provide water for irrigation along their courses, but the small streams provide little water. Ground-water supplies in the underlying basalt are small and mostly untapped.

Soils: Most of the soils are Xerolls. They are well drained or somewhat excessively drained and have a mesic temperature regime. Nearly level to moderately steep, deep and moderately deep, silty Haploxerolls (Ritzville, Walla Walla, Condon, and Valby series) formed in loess on uplands. Nearly level, deep, medium textured Haploxerolls (Onyx, Hermiston, and Esquatzel series) are on flood plains. Shallow, stony Haploxerolls (Licksillet, Bakeoven, and Kuhl series) are on ridgetops and steep south slopes. Moderately deep Haploxerolls (Wrentham series) are on steep north slopes.

Potential natural vegetation: This area supports shrub-grass associations. Big sagebrush and bluebunch wheatgrass are dominant on the moderately deep to very deep, gently sloping to moderately sloping soils and on soils that have steep and very steep south exposures. Big sagebrush and Idaho fescue are dominant on most moist sites and on moderately steep to very steep north exposures. Stiff sagebrush, low sagebrush, and Sandberg bluegrass are dominant on shallow and very shallow, stony soils. Small stands of ponderosa pine, with oak on warmer sites along the Columbia River, are on north slopes, in canyons and draws, and along stream channels. Dwarf hardwoods of hackberry and maple also grow in canyons and draws. Snowberry is the most common shrub in the pine stands. Poison-oak is the most common shrub in the oak stand.

9—Palouse and Nez Perce Prairies

Idaho, Oregon, and Washington

23,140 km² (8,940 mi²)

Land use: Less than 30 percent of this area is federally owned. Nearly all the remainder is in farms and ranches. About 40 percent, including most of the publicly owned land, is rangeland. About 50 percent is cropland, most of which is dry-farmed to wheat,

peas, and lentils. About 1 percent is irrigated and used for growing vegetables and other specialty crops. Small wooded areas and urban areas make up about 10 percent.

Elevation and topography: Elevation along the major streams is about 200 m, but in most of the plain it ranges from 600 to 1,200 m. The loess-covered basalt plain is moderately to strongly dissected; slopes are mostly hilly and steep. The major streams have cut deep canyons.

Climate: *Average annual precipitation*—375 to 625 mm. Precipitation is evenly distributed throughout fall, winter, and spring; summers are relatively dry. Snow falls in winter. *Average annual temperature*—7 to 12°C. *Average freeze-free period*—100 to 170 days, decreasing with elevation.

Water: Precipitation is adequate for dry farming. Most irrigated areas are adjacent to large streams. Ground-water supplies are small and mostly untapped.

Soils: Most of the soils are Xerolls, but Albolls, Aquolls, and Xeralfs also occur in this area. These soils have a mesic temperature regime and a mixed mineralogy. Haploxerolls (Asotin, Athena, Bakeoven, Caldwell, Calouse, Garrison Linville, Palouse, and Snow series) formed mostly in deep loess or alluvium or in glacial outwash or deposits shallow to bedrock. Argixerolls (Gwin, Larkin, and Waha series), some of which are deep and others shallow, formed in loess or mixed loess and colluvium. Argialbolls (Latah, Tilma, and Thatuna series) are deep soils that formed in loess. Deep, somewhat poorly drained Argiaquolls (Konert and Konner series) formed in alluvium. Deep Haploxeralfs (Freeman and Garfield series) formed in loess.

Potential natural vegetation: This area supports grass, shrubs, and trees. Grassland of bluebunch wheatgrass and smaller amounts of Idaho fescue, Sandberg bluegrass, and needleandthread generally are at lower elevations and receive less rainfall. Shrub-grassland of snowberry and Idaho fescue or of big sagebrush with Idaho fescue and bluebunch wheatgrass are mainly at higher elevations. Rose, common cowparsnip, black hawthorn, and arrowleaf balsamroot are also important. Woodlands of ponderosa pine with bluebunch wheatgrass, Idaho fescue, snowberry, and ninebark on south and west slopes merge into Douglas-fir with pinegrass on north and east slopes.

10—Upper Snake River Lava Plains and Hills

Idaho and Oregon
44,870 km² (17,330 mi²)

Land use: Nearly three-fifths of this MLRA is federally owned; most of the remainder is in farms or ranches. More than 90 percent is rangeland. About 5 percent of the total area, land bordering the large streams, is

irrigated and used for growing potatoes and small grains and for pasture. Small tracts of deep soils are dry-farmed.

Elevation and topography: Elevation ranges from 400 to 2,000 m, increasing from west to east. The lava plains and hills are nearly level to steeply sloping. Deep alluvial deposits are in valleys and on fans adjacent to the mountains. The major streams are deeply entrenched, especially in the western part. Isolated mountain ranges occur throughout the area.

Climate: *Average annual precipitation*—250 to 500 mm. Precipitation is evenly distributed throughout fall, winter, and spring but is low in summer. *Average annual temperature*—4 to 13°C. *Average freeze-free period*—60 to 165 days, decreasing from west to east and with elevation.

Water: The low to moderate precipitation is adequate for dryfarming on the smoother areas of deep soils. Streams provide enough irrigation water to meet present needs along the major valleys. Ground-water supplies are small and mostly untapped.

Soils: The dominant soils are Xerolls and Argids. They are well drained and moderately fine textured to fine textured and have a mesic temperature regime. Deep, rolling to hilly Argixerolls (Gem, Simas, and Tub series) are on uplands. Shallow, gently sloping to steep, stony Argixerolls (Ruckles series) are on uplands underlain by basalt. Moderately deep, sloping to very steep Haploxerolls (Loveline series) are on uplands. Nearly level to sloping Durargids (Madras and Lookout series) are on plateaus. These soils have a duripan.

Potential natural vegetation: This area supports a shrub-grass association. Big sagebrush and bluebunch wheatgrass are dominant on the moderately deep to very deep soils and on steep and very steep south exposures. Big sagebrush and Idaho fescue are dominant on moist sites. Stiff sagebrush, low sagebrush, and Sandberg bluegrass are dominant on drier sites. Antelope bitterbrush and Idaho fescue grow on moist sites at high elevations. Western juniper is common on the drier, stonier sites. Curlleaf mountainmahogany grows at high elevations.

11—Snake River Plains

Idaho and Oregon
35,250 km² (13,610 mi²)

Land use: Nearly half of this area is federally owned; the remainder is in farms and ranches. Most of the federally owned land is rangeland. Forage production is low, and annual grasses have invaded much of the rangeland. The National Reactor Testing Station is in the northeast, and Craters of the Moon National Monument is on bare lava flows in the east. About one-fourth of the area, the plains bordering the Snake River and its tributaries, is irrigated. Potatoes, grain, sugar beets, beans, and alfalfa hay are

the principal crops. There is some irrigated pasture. Small tracts in places where the soils and moisture are favorable are dry-farmed.

Elevation and topography: Elevation ranges from 600 to 1,700 m. These nearly level to steeply sloping lava plains have a thin to moderately thick cover of loess. In places, the rivers are in deep, steep-walled canyons. Alluvial fans, terraces, and bottom land are gently sloping to moderately sloping.

Climate: *Average annual precipitation*—175 to 325 mm. There is little or no precipitation in summer. *Average annual temperature*—5 to 11°C. *Average freeze-free period*—90 to 170 days, lowest in the northeast.

Water: Large quantities of water are available for irrigation along the Snake River and its tributaries. Ground water is plentiful in some of the deep alluvial deposits throughout the area and in the lavas north of the Snake River in eastern and south-central Idaho. It is used extensively for irrigation. Water is scarce on sites far from the major rivers, and these sites depend on local precipitation for water.

Soils: Dominant soils are Orthids, Argids, and Orthents. They have a mesic or frigid temperature regime. Deep and moderately deep, silty Calciorthids (Portneuf and Pancheri series), Haplargids (Power series) and Camborthids (Trevino and Tenno series) are on loess-covered plains of the west and central parts of the area. Durorthids (Minidoka and Nyssa series) and Durargids (Purdam and Chilcott series) that have a hardpan are on older land surfaces. Moderately coarse textured Torriorthents (Turbyfill and Umapine series), Camborthids (Vining series), Calciorthids (Declo series), and Calcixerolls (Bannock series) are extensive in the central and eastern parts of the area.

Potential natural vegetation: This area supports shrub-grass vegetation. Big sagebrush, winterfat, shadscale, Indian ricegrass, needleandthread, Thurber needlegrass, and Sandberg bluegrass grow on the lower Snake River Plains. Big and threetip sagebrush, bluebunch wheatgrass, Thurber needlegrass, and arrowleaf balsamroot grow on the middle Snake River Plains. The upper Snake River Plains support bluebunch wheatgrass and big sagebrush. Black sagebrush and gardner saltbush are dominant on some soils. Phlox, tapertip hawksbeard, biscuitroot, and penstemon are also important.

12—Lost River Valleys and Mountains

Idaho

16,380 km² (6,320 mi²)

Land use: Nearly all this area is federally owned. The high mountain slopes are forested, and some lumber is produced. The low grass and shrubs on the slopes and in the valleys are grazed. Irrigated land in the valleys, making up about 1 percent of the area, is

used mostly for hay and pasture, but potatoes and small grains are also grown.

Elevation and topography: Elevation ranges from 1,400 m in the valleys to more than 3,100 m at the highest mountain crests. Steep to very steep mountains underlain by mixed sedimentary rocks and volcanic rocks make up about 50 percent of the area. The large valleys, deeply mantled by recent alluvium and some lacustrine deposits, are level to moderately steep.

Climate: *Average annual precipitation*—175 to 275 mm in the valleys and 625 mm or more on mountain crests. *Average annual temperature*—3 to 7°C in the valleys but much lower in the mountains. *Average freeze-free period*—80 to 110 days in the valleys. Frost occurs every month of the year in the high mountains.

Water: The moderate precipitation provides enough moisture for grass and shrubs to grow on mountain slopes. The valleys depend on the streamflow of the Salmon, Lemhi, Pahsimeroi, Big Lost, and Little Lost Rivers for water for livestock and irrigation. Springs and deep wells in the valleys supply a small amount of ground water for domestic uses and for irrigation.

Soils: Major soils of the valleys are Orthids, Orthents, Aquolls, and Xerolls, which have a frigid temperature regime. The dominant soils of the mountains are Rendolls, Borolls, Orthents, and Ochrepts, which have a cryic temperature regime. Moderately deep, gently sloping, gravelly, medium textured Calciorthids (McCaleb series) and shallow, very gravelly Torriorthents (Ramshorn series) are on low alluvial fans and terraces. Moderately deep, nearly level, poorly drained, medium textured Haplaquolls (Tew series) are on stream bottoms and terraces. Moderately deep, gravelly, medium textured Argixerolls (Soelberg series) are on high alluvial fans near the mountains. Shallow, very gravelly, medium textured Rendolls (Sheege series) are on south-facing slopes. Moderately deep, medium textured Cryoborolls (Pavohroo series) are on north-facing slopes. Shallow, stony Cryorthents and Cryochrepts are on the highest mountains.

Potential natural vegetation: This area supports desert shrub, shrub-grass, and forest vegetation. Indian ricegrass, needleandthread, shadscale, gardner saltbush, and scarlet globemallow are major species in the valleys. Big and low sagebrush, winterfat, bluebunch wheatgrass, Sandberg bluegrass, and a variety of forbs grow on mountain foot slopes. Bluebunch wheatgrass, prairie junegrass, oniongrass, Indian paintbrush, lupine, sedge, big and low sagebrush, and rabbitbrush grow on low mountain slopes. Curlleaf mountainmahogany, Douglas-fir, aspen, and Rocky Mountain juniper grow on high mountain slopes.

13—Eastern Idaho Plateaus

Idaho

21,010 km² (8,110 mi²)

Land use: Nearly three-fourths of this area is in farms and ranches; the remainder is federally owned. Most of the Fort Hall Indian Reservation is in this MLRA. About one-fourth of the area is dry-farmed, and wheat is the major crop. An additional 10 percent, land along some of the large streams, is irrigated and used largely for alfalfa hay, meadows, and pasture, but some small grains and potatoes are grown. About one-half of the area is rangeland. About 10 percent, consisting of high mountain slopes, is in forests that produce some timber.

Elevation and topography: Elevation ranges from 1,400 to 2,000 m in plains and plateaus and from 2,300 to 2,600 m on mountain crests, but on some peaks it is more than 3,100 m. The dissected plateaus and plains are underlain mainly by sedimentary rocks and some volcanic rocks that are mantled by loess on gentle and moderate slopes. Lacustrine deposits and deep alluvium fill some level valleys and basins. The plains and plateaus are separated by many rugged but discontinuous mountain ranges of folded sedimentary rocks.

Climate: *Average annual precipitation*—300 to 625 mm. Minimum precipitation is from midsummer through autumn. *Average annual temperature*—4 to 7°C., but it is lower in the mountains. *Average freeze-free period*—50 to 120 days. Frost occurs every month of the year in the high mountains.

Water: Precipitation provides water for dryfarming and grazing, but careful management is needed to make the best use of the limited amount. Several large streams that flow through the area supply water for irrigation, mainly outside the MLRA. Small but important tracts are irrigated along the Bear, Portneuf, Blackfoot, Snake, and Teton Rivers. Ground water is scarce except near the large streams.

Soils: The dominant soils are Xerolls and Borolls. They have a frigid or cryic temperature regime, depending largely on elevation. Deep, silty Argixerolls (Bancroft series) and Haploxerolls (Rexburg series) are major soils on the loess-covered plains. Deep, silty Cryoborolls (Tetonia and Lanark series) are on foothills. Moderately deep, gravelly, medium textured Cryoborolls (Driggs series) are on alluvial fans and terraces near the mountains. Shallow, skeletal, medium textured Rendolls (Sheege series) are on south-facing slopes of the mountains. Moderately deep, medium textured Cryoborolls (Pavohroo series) are on north-facing slopes.

Potential natural vegetation: This area supports grass-shrub vegetation. Bluebunch wheatgrass and big sagebrush are dominant. Arrowleaf balsamroot is common. Prairie junegrass, Sandberg bluegrass, Nevada bluegrass, oniongrass, slender wheatgrass, milkvetch, lambstongue fawnlily, phlox, penstemon, antelope bitterbrush, rabbitbrush, snowberry, and low Oregon-grape are other important plants. Scattered stands of Douglas-fir and aspen grow on north slopes and on the more moist soils.

C—CALIFORNIA SUBTROPICAL FRUIT, TRUCK, AND SPECIALTY CROP REGION

167,570 km² (64,700 mi²)

This region of low mountains and broad valleys has a long warm growing season and low precipitation. The average annual precipitation ranges from 1,025 mm to less than 250 mm. Very little precipitation falls from late in April through October. The average annual temperature is 16 to 18°C in most of the region but is as low as 0°C at some of the higher elevations. The average freeze-free period is 230 to 270 days in much of the region, but it is 125 days or less in some of the higher mountains and more than 350 days in the valleys of the south.

Xeralfs, Xererts, and Xerolls are extensive on uplands and older terraces throughout the region, but Fluvents, Orthents, and Ochrepts on flood plains and alluvial fans are the most important soils for agriculture. Many of the soils on flood plains and low terraces are affected by salts and must be skillfully managed for good crop production.

This region has a wide variety of crops and agricultural enterprises. Citrus fruits, other subtropical and tropical fruits, and nuts are major crops in the southern half. Many kinds of vegetables, grown mainly under irrigation, are produced throughout the region. Rice, sugar beets, cotton, grain crops, and hay are also important crops. Dairying is a major enterprise near the large cities. Beef cattle production on feedlots and range is also important.

14—Central California Coastal Valleys

California

10,380 km² (4,000 mi²)

Land use: Most of this MLRA is in farms and ranches; about 20 percent is used for urban development, and the acreage used for this purpose is increasing rapidly. The gently sloping soils in the valleys are intensively farmed to many kinds of crops. Truck crops, wine grapes, strawberries and other fruits, cut flowers, small grains, hay, and pasture are the principal crops grown on irrigated land. Small grains are the principal crops on dry-farmed areas. Dairy farming is an important enterprise near the large cities. The more sloping fans and foothills, making up one-fourth or more of the area, are in native range used for livestock grazing. Sites along streams are susceptible to flooding and bank cutting. If the plant cover on soils on terraces is removed, the hazard of erosion is severe in winter. Soils on hills are coarse textured, and the hazards of soil blowing and water erosion are severe if the plant cover is removed.

Elevation and topography: Elevation ranges from sea level to 600 m, but it is less than 300 m in most of the area. This area is a network of gently sloping valley floors bordered by higher and more sloping terraces and fans and by steep uplands.

Climate: *Average annual precipitation*—300 to 750 mm. This area is very dry from midspring to midautumn. *Average annual temperature*—13 to 17°C. *Average freeze-free period*—210 to 300 days; the longest period occurs along the coast.

Water: The low to moderate rainfall and local streamflow are inadequate to meet present water needs. Water from adjoining MLRA's is brought in for agriculture and for the domestic and industrial requirements of the many large cities. The yield of ground water in the

deeper alluvial deposits, especially in Santa Clara Valley, is declining, and the intrusion of seawater is reducing the quality of the water.

Soils: The dominant soils are Xeralfs, Xerolls, Xererts, Xerults, Aquents, Orthents, and Psammments. They have a thermic or isomesic temperature regime. Fluvaquents (Alviso series), Pelloxererts (Clear Lake series), Haploxerolls (Pacheco series), and Hydraquents (Reyes series) are on flood plains and in tidal basins. Pelloxererts (Cropley series), Haploxerolls (Salinas, Sorrento, and Arroyo Seco series), Xerorthents (Yolo series), and Haploxeralfs (Zamora series) are on low terraces. Natrixeralfs (Antioch series), Haploxeralfs (Arbuckle and Pleasanton series), Argixerolls (Chualar series), Haploxerults (Haire series), Palexeralfs (Positas series), and Natrixerolls (Watsonville series) are on old terraces and alluvial fans. The gently sloping Xeropsammments (Oceano and Marina series) are on hills.

Potential natural vegetation: This area supports grasses, brush, and trees. Naturalized annual grasses and forbs are dominant in many places. Soft chess, wild oats, bromes, fescues, filaree, burclover, and some remnant perennials are major species. Scattered valley oak grows on the well drained soils. Saltgrass, iodinebush, and other salt-tolerant plants grow in tidal areas. In places, there are a few remnant stands of redwood trees.

15—Central California Coast Range

California

21,900 km² (8,460 mi²)

Land use: More than four-fifths of this area is in farms and ranches; most of the remainder is federally owned. About 10 percent is dry-farmed to grain, and slightly more than 50 percent is in range of native

grasses and brush. Open woodland, also used for grazing, makes up nearly 35 percent of the area. Small acreages are forests and urban areas. The erosion hazard is severe in dry-farmed orchards and grainfields. If the plant cover is removed from the soils by fire, overgrazing, cultivation, or logging, the hazard of erosion is severe because of steep slopes and high-intensity rainfall.

Elevation and topography: Elevation ranges from sea level to 800 m in most of the area, but it is 1,500 m in some mountains. Gently sloping to steep low mountains underlain mostly by shale and sandstone and partly by igneous and volcanic rocks cover most of the area. Coastal plains are narrow and discontinuous, and stream valleys are narrow and widely separated.

Climate: *Average annual precipitation*—300 to 1,025 mm, but it is 375 to 750 mm in most of the area. Precipitation is evenly distributed throughout fall, winter, and spring but is very low in summer. Coastal areas receive some moisture from fog in summer. *Average annual temperature*—13 to 18°C. *Average freeze-free period*—120 to 270 days.

Water: The low to moderate rainfall and moderate streamflow limit agriculture to dryfarming in most of the area. Ground-water supplies are limited.

Soils: The dominant soils are Xererts, Xerolls, Ochrepts, Xeralfs, Orthents, and Psamments. They have a thermic temperature regime (mesic at the highest elevations). Soils on hills are the rolling to steep Chromoxererts (Altamont series), Argixerolls (Chamise and Los Osos series), Xerochrepts (Millsholm series), Haploxeralfs (Dibble series), and Haploxerolls (San Benito, Linne, and Santa Lucia series). Also on hills are the gently sloping to steep Palexeralfs (Spreckles series), Xerorthents (Shedd series), and Haploxerolls (Nacimiento series). Soils on uplands are the strongly sloping to steep Xeropsamments (Arnold series), Xerorthents (Gaviota series), Argixerolls (Los Gatos, Gilroy, and Henneke series), Haploxerolls (Montara, Sheridan, and Sur series), Xerochrepts (Maymen and Toomes series), and Haploxeralfs (Vallecitos series). Rock outcrop is common.

Potential natural vegetation: This area supports grasses, grass-oak, and shrub vegetation. Naturalized annuals, including soft chess, bromes, fescues, wild oats, filaree, and burclover characterize the open and oak grasslands. Blue oak, valley oak, and canyon live oak are the dominant trees. California sagebrush, coyotebrush, chamise, manzanita, ceanothus, and scrub oak are the major brush species. Along the west side of the Coast Range are forests of Douglas-fir, madrone, grand fir, tanoak, bigleaf maple, and a few remnant stands of redwood trees. Stands of ponderosa pine with madrone, black oak, live oaks,

California buckeye, manzanita, and ceanothus are on drier sites.

16—California Delta

California

2,310 km² (890 mi²)

Land use: Nearly all this area is farmed. Important crops are asparagus, sugar beets, potatoes, corn, grain, and hay grown under intensive management. Fruit trees, mainly pear, are grown on slopes of the protecting levee system. Erosion of the levees by wave action is a continuous land use problem. Subsidence of the peat and muck soils is also a problem.

Elevation and topography: Elevation ranges from below sea level to slightly above sea level. Many streams divide this nearly level delta into islands. Strong protective levees and adequate drainage are needed to protect this area from flooding.

Climate: *Average annual precipitation*—325 to 375 mm. Summers are dry. *Average annual temperature*—About 16°C. *Average freeze-free period*—About 270 days.

Water: Water for agriculture comes mostly from the many sloughs and waterways that cross the area. Controlling salinity and salt water intrusion is a major concern of management.

Soils: The dominant soils are Saprists, Aquolls, Fluvents, Hemists, Aquepts, and Aquepts. They have a thermic temperature regime. Organic Medisaprists (Rindge and Kingile series) and Haplaquolls (Egbert and Ryde series) formed in freshwater marshes. Moderately well drained to poorly drained soils on natural river levees are Xerofluvents (Columbia series) and Haplaquolls (Sacramento series). Medisaprists (Joice series), Medihemists (Suisun series), Hydraquents (Reyes series), and Haplaquepts (Valdez series) formed in brackish water marshes.

Potential natural vegetation: This area supports marsh vegetation. Fat-hen saltweed, brass buttons, alkali bulrush, cattails, tules, saltgrass, and pickleweed characterize this area.

17—Sacramento and San Joaquin Valleys

California

49,580 km² (19,140 mi²)

Land use: More than 90 percent of this MLRA is in farms and ranches. Much of the remainder is federally owned. About 2 or 3 percent is urban, and the acreage used for this purpose is increasing rapidly. Slightly more than half the area is cropland, three-fourths or more of which is irrigated. The cropland in this MLRA represents 60 percent of the cropland in California, and the irrigated cropland is 80 percent of the irrigated land in the state. Cotton, fruits, nuts, grapes, hay, grain, pasture, rice, alfalfa, citrus, and

tomatoes are among the principal crops grown on irrigated land. The more sloping, nonirrigated cropland is dry-farmed to grain. About a third of the area is in native grasses, brush, and open woodland and is used mostly for grazing. If the plant cover on sloping soils on terraces is removed, erosion is a hazard. The hazard of wind erosion is severe on the sandy, wind-modified soils in the San Joaquin Valley if a plant cover is not maintained.

Elevation and topography: Elevation ranges from sea level to 200 m. This area includes the valley basins adjacent to the Sacramento and San Joaquin Rivers, fans and flood plains of tributary streams, and terraces around the edge of the valley.

Climate: *Average annual precipitation*—125 to 625 mm. Summers are long, hot, and dry, and winters are cool and rainy. *Average annual temperature*—16 to 19°C in most of the area but as low as 13°C in the north. *Average freeze-free period*—230 to 350 days, increasing from north to south.

Water: Because of the low rainfall and relatively small streamflow, water is scarce in many parts of the area. Water for irrigated crops comes from stream diversions, wells, and canals of organized irrigation districts that obtain most of their water from state and federal water systems.

Soils: The dominant soils are Xeralfs, Xerolls, Xererts, Aquents, Aquolls, Ochrepts, Orthents, Fluvents, Psamments, and Argids. They have a thermic temperature regime. Soils in basins are Xerofluvents (Columbia series), Pelloxererts (Willows and Clear Lake series), Chromoxererts (Capay series), Haploxerolls (Merced series), Natrixeralfs (Solano and Pescadero series), Haploxeralfs (Traver series), Haplaquents (Tulare series), and Haplaquolls (Sacramento series). Soils on fans and flood plains are Xerorthents (Yolo and Hanford series), Haploxerolls (Chino and Grangeville series), Torriorthents (Panoche series), Xerofluvents (San Emigdio series), Haploxerolls (Sorrento series), Natrargids (Lethent series), Haploxeralfs (Wyman and Zamora series), and Haplargids (Panhill series). Soils on low terraces are Durixeralfs (Fresno and Madera series) and Durochrepts (El Peco series). Soils on terraces are Durixeralfs (San Joaquin, Exeter, and Redding series) and Paleixeralfs (Red Bluff and Corning series). Sandy soils in the San Joaquin Valley are Xeropsamments (Delhi, Calhi, and Tujunga series).

Potential natural vegetation: This area supports naturalized annuals and scattered trees. Wild barley, wild oats, soft chess, ripgut brome, red brome, foxtail fescue, burclover, and filaree are dominant species. Scattered oaks on terraces and oak, willow, and cottonwood grow along the rivers and streams and in the overflow areas. Saltgrass, along with such shrubs as iodinebush and Australian saltbush, grow on saline-sodic soils on terraces and in basins.

18—Sierra Nevada Foothills

California

7,300 km² (2,820 mi²)

Land use: About four-fifths of this MLRA is in farms and ranches; most of the remainder is federally owned. Production of livestock on range is the principal enterprise. Approximately 75 percent of the area is range, 5 percent cropland, and the remainder brushland and open forest. Most of the cropland is dry-farmed to grain, but small tracts are used for growing fruit, nuts, and grapes under irrigation. The hazard of erosion is moderate to severe on the soils if the plant cover is removed by overgrazing, cultivation, or fire.

Elevation and topography: Elevation ranges from 200 to 500 m, but on some isolated mountain peaks it is 1,200 m. In this area of rolling to steep dissected hills and low mountains, the stream valleys are narrow and fairly steep.

Climate: *Average annual precipitation*—350 to 900 mm. Summers are hot and dry, and winters are cool and moist. *Average annual temperature*—13 to 18°C. *Average-freeze-free period*—200 to 320 days.

Water: The moderate rainfall and intermittent streamflow are the major water sources. Ground-water supplies are small and mostly untapped. Numerous stock ponds are scattered throughout the area, but little has been done to construct small reservoirs for irrigation.

Soils: The dominant soils are Ochrepts, Xeralfs, Xerolls, and Orthents. They have a thermic temperature regime. Shallow soils include Xerochrepts (Hornitos, Toomes, and Auburn series), Xerorthents (Dauston, Whiterock, and Exchequer series), and Argixerolls (Henneke series). Moderately deep and deep soils are Haploxeralfs (Rescue, Argonaut, Ahwahnee, Auberry, and Sierra series) and Xerochrepts (Vista series).

Potential natural vegetation: This area supports naturalized annual grasses, shrubs, and trees. Soft chess, wild oats, filaree, burclover, ripgut brome, and foxtail fescue are dominant species on rangeland. An overstory of scattered individuals to very dense stands of blue oak and Digger pine, with scrub live oak as an important component, grow in some places. Chamise, manzanita, wedgeleaf ceanothus, yerbasanta, and poison-oak are dominant on brushland. Scattered stands of ponderosa pine, mixed with manzanita and black oak, are at the upper elevations of the more moist sites. At the upper elevations, small stands of Douglas-fir grow on north slopes along major streams.

19—Southern California Coastal Plain

California

51,500 km² (19,890 mi²)

Land use: More than one-fourth of this area is federally owned. About one-fifth is urban or is in built-up

areas, and other land is rapidly being converted to this use. One-third or more of the area is brushland used for watershed protection. Preventing fires on this land is a major concern of management. Irrigated cropland, making up 10 to 20 percent of the area, is used for growing subtropical fruits, deciduous fruits, grain, truck crops, grapes, hay, and pasture. Dairy farming and flower seed production are other important enterprises. Some livestock are produced on rangeland. The erosion hazard is slight on the soils in valleys and on terraces and benches of the valleys. The hazard of sheet and gully erosion is severe on the sloping soils on coastal terraces and benches and on the upland soils if they are unprotected in winter.

Elevation and topography: Elevation ranges from sea level to 600 m. These gently sloping to strongly sloping and dissected coastal plains are bordered by steep hills.

Climate: *Average annual precipitation*—250 to 625 mm. Summers are dry, but fog provides some moisture along the coast. *Average annual temperature*—16 to 18°C. *Average frost-free-period*—365 days along the coast, decreasing to 250 days in the hills.

Water: The low rainfall and intermittent streamflow provide small quantities of water for local use. Ground-water resources have been heavily exploited, and declining water tables and salt intrusion are reducing both the quantity and quality of the water. Much of the water for irrigation and nearly all the water for large urban areas comes from the Colorado River and from northern California.

Soils: The dominant soils are Xeralfs, Ochrepts, Orthents, Xererts, Xerolls, Psamments, and Fluvents. They have a thermic temperature regime. Soils on coastal terraces and benches are Xerofluvents (Camarillo series), Palexeralfs (Olivenhain, Milpitas, and Las Flores series), Xeropsamments (Marina series), Durixeralfs (Redding series), and Durochrepts (Carlsbad series). Soils in valleys are Haploxeralfs (Greenfield and Traver series), Xerorthents (Hanford series), Xerofluvents (San Emigdio series), and Haploxerolls (Sorrento series). Soils on terraces and benches along the sides of the main valleys are Durixeralfs (Monserate series), Natrixeralfs (Placentia series), and Haploxeralfs (Rincon series). Soils on uplands are Haploxeralfs (Cajalco and Fallbrook series), Xerorthents (Cienega and Gaviota series), Chromoxererts (Alo series), Pelloxererts (Diablo series), Haploxerolls (Hambright, Friant, Lodo, and San Benito series), and Xerochrepts (Vista series). Rock outcrop is common.

Potential natural vegetation: This area supports annual and perennial grasses, shrubs, and trees. Wild oats, soft chess, red brome, filaree, burclover, needlegrass, tarweed, mustard, and annual lupine interspersed with scattered individual to dense stands of oak grow on rangeland. Stands of brush include

buckwheat, ceanothus, California sagebrush, chamise, and scrub oak. A unique stand of rare Torrey pine grows in this area between Del Mar and Solana Beach.

20—Southern California Mountains

California

24,600 km² (9,500 mi²)

Land use: More than two-fifths of this area is federally owned. About 5 percent is used for urban development, and the remainder is in farms, ranches, or other private holdings. About one-fifth of the total area is open woodland and brushland used for grazing. About half of the area has a brush cover that is not grazed. Most of the larger valleys are dry-farmed to grain and hay, but in places fruits are grown under irrigation. The erosion hazard is severe on the soils of this area if the plant cover is depleted or destroyed by overgrazing or fire. Preventing or controlling brush fires is a major concern of management.

Elevation and topography: Elevation ranges from 600 to 2,400 m in most of the area, but on some peaks elevation is as much as 3,700 m, and a narrow strip along the northern edge is almost at sea level. These strongly sloping to precipitous mountains have unstable slopes and sharp crests. Valleys are narrow, and many have streams actively eroding by bank cutting.

Climate: *Average annual precipitation*—400 to 1,025 mm. Summers are dry. A little snow falls in winter but does not last. *Average annual temperature*—0 to 16°C, decreasing with elevation. *Average freeze-free period*—100 to 200 days in most of the area, decreasing with elevation, but as long as 250 days along the western edge.

Water: The moderate rainfall provides water for brushland and range and also meets part of the water needs of adjacent lower areas. Deep sand and gravel deposits in the valleys yield water for livestock and domestic use and for some irrigation.

Soils: The dominant soils are Xerolls and Xeralfs. They have a mesic temperature regime. Haploxerolls (Sheephead, La Posta, Tollhouse, and Crouch series), Haploxeralfs (Holland series), and areas of rock outcrop are on mountain slopes. Well drained Haploxerolls (Calpine, Mottsville, and Oak Glen series) and poorly drained Haplaquolls (Bishop series) are on alluvial fans and in basins. Detailed soil survey information is lacking.

Potential natural vegetation. This area supports forest, brush, and shrub-grass mixtures. Open stands of Jeffrey pine, Coulter pine, sugar pine, Douglas-fir, incense-cedar, and oak are at the higher elevations. The greater part of the area is covered with sparse to dense stands of brush. Scrub oak, juniper, chamise, ceanothus, manzanita, and red shank are typical

species. The soils used as rangeland support naturalized annual and native perennial grasses and brush. California juniper, big sagebrush, flattop buckwheat, needlegrass, wild oats, soft chess, cheatgrass, and filaree characterize the plant cover on the coarse textured soils. Oaks and Jeffrey pine and an under-

story of soft chess, wild oats, needlegrass, blue wildrye, ceanothus, flattop buckwheat, and other brush species grow on the medium textured soils. Creeping wildrye, pine bluegrass, sedges, native clovers, wiregrass, and blue wildrye are major species in the wet meadows.

D—WESTERN RANGE AND IRRIGATED REGION

1,461,300 km² (564,210 mi²)

This is a semidesert to desert region of plateaus, plains, basins, and many isolated mountain ranges. The average annual precipitation is 250 mm or less in most of the plains and basins but more than 1,275 mm in some of the higher mountains. In the southeast, most of the precipitation falls as rain during the warm season, but elsewhere most of the precipitation falls during the cool season. In most of this region, the average annual temperature is 7 to 13°C, but it ranges from 2°C at the higher elevations in the north to more than 21°C in some of the lowlands in the south. The freeze-free period ranges from less than 90 days in the north and in some of the higher mountains to more than 240 days in the south.

Orthids, Fluvents, Orthents, and Xererts are extensive on the plains and plateaus and in valleys throughout the region. Xerolls, Ochrepts, and Boralfs are on mountain slopes. Argids on plains and in basins and Orthents on mountain slopes are also important.

Much of the land in this region is used for range, but irrigation is practiced in places where water is available and the soils are suited. Feed crops for livestock are grown on much of the irrigated land. Peas, beans, and sugar beets are grown in many places. Cotton and citrus fruits are important crops in southwestern Arizona.

21—Klamath and Shasta Valleys and Basins

California and Oregon
35,350 km² (13,650 mi²)

Land use: About one-half of this area is federally owned; the remainder is in farms and ranches. Between 5 and 10 percent of the land is irrigated and used for growing potatoes, grain, seed crops, hay, and pasture. An additional 1 or 2 percent is dry-farmed to grain. Most of the remaining land, both privately and publicly owned, is grazed. Some forest trees are harvested for lumber. Maintaining good drainage is the principal concern of management in the valley basins. Some sites need protection from overflow, and others are affected by alkali. The erosion hazard is slight except for gulying and flood scour.

Elevation and topography: Elevation ranges from 800 to 1,400 m, but on some mountain peaks it is 1,800 m or more. Lava plateaus and many valleys and basins make up most of the area. Steep mountain spurs and rimrock escarpments surround the plateaus.

Climate: *Average annual precipitation*—250 to 500 mm in most of the area but as much as 750 mm at higher elevations. Summers are dry. *Average annual temperature*—7 to 11°C. *Average freeze-free period*—70 to 140 days, decreasing with elevation.

Water: The low precipitation and the consequent erratic flow of local streams limit the supply of water for agriculture. Ground water is scarce in the dense lava rocks underlying much of the area. On sites underlain by more porous rocks, ground-water supplies are large but mostly untapped.

Soils: The dominant soils are Xerolls, Aquolls, Aquepts, Aquent, Xererts, Albolls, and Argids. They have a mesic or frigid temperature regime. Soils in basins

and on flood plains and terraces are Andaquepts (Tulana series), Argialbolls (Goose Lake series), Pelloxererts (Pitts series), Durargids (Trosi series), Halaquepts (Lolak series), Natrargids (Rumbo series), Durixerolls (Bieber series), Haploxerolls (Mottsville series), Argixerolls (Trojan, Galeppi, and Drews series), and Haplaquolls (Ramelli and Deven series). Soils on upland plateaus and mountains are Argixerolls (McQuarrie series), Haplargids (Casuse and Saralegui series), Chromoxererts (Karcals series), and Durargids (Packwood series). Large areas of rock outcrop are on the plateaus and in the mountains.

Potential natural vegetation: This area supports a cover of shrubs interspersed with annual and perennial grasses. Nevada bluegrass, Sandberg bluegrass, Idaho fescue, bluebunch wheatgrass, and cheatgrass are major species. Soils in basins and meadows have a cover of sedges, wiregrass, slender wheatgrass, creeping wildrye, and bluegrass. Sagebrush, rabbitbrush, bitterbrush, and mountainmahogany are the dominant shrubs. Western juniper is common, and scattered ponderosa pine grows in places where precipitation is less than 375 mm. In zones where precipitation is higher than 375 mm, there are forests of ponderosa pine, Douglas-fir, white fir, and California red fir, and bitterbrush and ceanothus are in the understory.

22—Sierra Nevada Range

California and Nevada
65,190 km² (25,170 mi²)

Land use: More than one-half of this area is federally owned. The Yosemite and Sequoia National Parks are in this area. The remainder is privately owned woodland, farms, and ranches. About 90 percent of the land consists of forests used for timber, recreation, wildlife habitat, and watershed. Approximately 8 percent is pasture and range, and less than 1

percent is cropland. The erosion hazard is severe if the soils are disturbed by logging, fires, overgrazing, and cultivation. Soils in mountain valleys and meadows are susceptible to gullying and streambank erosion.

Elevation and topography: Elevation ranges from 500 to 2,400 m, but on some mountain peaks (Mt. Shasta and Mt. Whitney) it is more than 4,300 m. Most of the area consists of strongly sloping to precipitous mountains cut by many steep valleys. Some plateau remnants and mesas are in this area.

Climate: *Average annual precipitation*—1,025 to 1,525 mm in much of the area but as low as 625 mm in the lower valleys and foothills and as much as 1,775 mm on the mountain peaks. Precipitation increases with elevation and from south to north. Summers are dry, but there are occasional thundershowers. Much of the winter precipitation is snow. *Average annual temperature*—2 to 14°C, decreasing with elevation. *Average freeze-free period*—30 to 180 days, decreasing with elevation.

Water: The abundant precipitation and snowfields on the higher mountain slopes supply water to many large perennial streams. Much of this water is stored in large reservoirs and is used in the Sacramento and San Joaquin Valleys and in southern California.

Soils: The dominant soils are Xerults, Humults, Xeralfs, Xerolls, Ochrepts, Umbrepts, Andepts, Orthents, Psamments, and Boralfs. They have a mesic, frigid, or cryic temperature regime, depending largely on elevation. Soils at an elevation below 1,200 to 1,500 m are Haplohumults (Sites and Aiken series), Haploxeralfs (Secca, Holland, and Cohasset series), Xerochrepts (Chaix and Maymen series), Haploxerults (Josephine and Mariposa series), Vitrandepts (Iron Mountain and Jiggs series), and Haploxerolls (Shaver series). Soils at higher elevations are Xerorthents (Dinkey series), Xeropsamments (Corbett and Toiyabe series), Cryopsamments (Cagwin series), Cryoboralfs (Fugawee series), Cryumbrepts (Meeks series), Cryochrepts (Umpa series), Cryandepts (Meiss and Waca series), and Dystrandeps (Windy series). Large areas of rock land are scattered throughout the area and on broad expanses on ridge crests and peaks above timberline (2,400 to 2,700 m). Soils in mountain valleys are Haploxerolls (Oak Glen series), Xeropsamments (Elmira series), Haploxeralfs (Inville series), Humaquepts (Chummy series), and Cryaquents. Soil survey information is lacking for extensive areas.

Potential natural vegetation: This area supports forest vegetation. Ponderosa pine, Douglas-fir, incense-cedar, sugar pine, white fir, California red fir, lodgepole pine, mountain hemlock, black oak, Oregon white oak, canyon live oak, and tanoak are major tree species. Bristlecone pine grows in protected draws at elevations above 2,400 to 2,700 m. Blue-

grass, hairgrass, sedges, wiregrass, clovers, and wild iris grow in meadows. Sagebrush, blue wildrye, fescues, bluegrasses, and mountain brome grow under open stands of timber.

23—Malheur High Plateau

California, Nevada, and Oregon

73,050 km² (28,210 mi²)

Land use: About three-fourths of this area is federally owned. Native range vegetation covers much of the area. Livestock production on range is the principal agricultural activity. About 1 or 2 percent of the area is irrigated, and grain and hay for winter feed and pasture are grown. Small areas on upper mountain slopes are forested.

Elevation and topography: Elevation ranges from 1,200 to 2,100 m, but on some mountains it is more than 2,700 m. Nearly level basins and valleys are bordered by long, gently sloping alluvial fans. North-south-trending mountain ranges and a few volcanic plateaus rise sharply above the valleys.

Climate: *Average annual precipitation*—200 to 350 mm in most of the area but as much as 500 mm on some of the higher mountain slopes. Precipitation is fairly evenly distributed throughout fall, winter, and spring but is low in summer. *Average annual temperature*—5 to 10°C. *Average freeze-free period*—30 to 140 days, decreasing with elevation.

Water: Water is scarce except at higher elevations where precipitation is greater. Streamflow is erratic and depends mostly on runoff from melting snow. The large ground-water supplies in the gravel- and sand-filled valleys are mostly untapped.

Soils: Most of the soils are Argids or Orthids. They are shallow to moderately deep, and have a medium textured to fine textured subsoil and a frigid or mesic soil temperature regime. Nearly level to sloping, well drained Durargids and Durorthids have a duripan and are on lake terraces and fans. Somewhat poorly drained Durorthids in low areas are commonly saline and sodic. Sloping to steep, well drained to excessively drained, shallow, stony Xerolls are on uplands.

Potential natural vegetation: This area supports a shrub-grass association. Big sagebrush, rabbitbrush, needlegrasses, and squirreltail are common on the extensive sandy and loamy soils. Big sagebrush and basin wildrye are on bottom lands. Spiny hopsage and bud sagebrush are on the drier sites. Greasewood, saltbush, and saltgrass grow on salty and sodic soils. Silver sagebrush grows on moist sites that have water intermittently, such as playas. Western juniper are on rocky sites. Growing at high elevations are aspen groves on moist sites and isolated stands of grand fir and whitebark pine.

24—Humboldt Area

Nevada and Oregon

37,310 km² (14,400 mi²)

Land use: About four-fifths of this area is federally owned. The remainder is used for farms, ranches, industrial enterprises (mining), and some urban and transportation purposes. Livestock grazing on native range is the principal agricultural enterprise. Less than 3 percent of the area, generally consisting of narrow strips along the major streams and margins of valleys, is irrigated and used for growing hay, grain, tame pasture, alfalfa seed, and potatoes. The hay produced in the area is used principally for winter feeding of resident livestock. Concerns of management are mainly use of proper grazing practices and efficient use of available surface and ground water supplies.

Elevation and topography: Elevation ranges from 1,200 to 1,800 m, but on some mountain peaks it is more than 2,700 m. A series of widely spaced north-south-trending mountain ranges are separated by wide valleys filled with alluvium and lacustrine materials.

Climate: *Average annual precipitation*—150 to 300 mm in most of the area but as much as 500 mm on some mountain slopes. Precipitation occurs mainly as snow in winter and as rain in spring and in autumn. Summers are dry. *Average annual temperature*—4 to 10°C. *Average freeze-free period*—60 to 120 days, decreasing with elevation.

Water: The low precipitation provides a small amount of water. Surface water is available from perennial and intermittent streams that carry snowmelt from the mountains. Late-season surface water supplies are deficient. Ryepatch Reservoir on the lower Humboldt River is the only large irrigation storage reservoir in the area. Ground water available in limited quantities in valley fill is being rapidly developed in irrigation of crops.

Soils: The dominant soils are Argids, Orthids, Orthents, Aquolls, and Psamments, which have a mesic temperature regime, in valleys and Xerolls, Borolls, and Orthids, which have a frigid or cryic temperature regime, on mountains. They have a mixed or montomorillonitic mineralogy. Soils in this area formed principally in mixed parent materials. Durargids (Cherry Spring and Boulflat series), Naduargids (Golconda series), Natrargids (Beowawe and Tomera series), Camborthids (Orovada and Rad series), Durorthids (Blackhawk and Bliss series), Torripsamments (Goldrun series), and Torriorthents (Valmy and Benin series) are on alluvial fans, stream and lake terraces, and flood plains. Haplaquolls (Humboldt and Ryepatch series) are on wet stream flood plains. Cryoborolls (Spinlin and Winevada series), Argixerolls (Gosumi and Sonocan series), and Camborthids (Mullyon

series) and areas of rock outcrop are on mountain slopes and upland basins.

Potential natural vegetation: This area supports shrub-grass vegetation. In places where the average annual precipitation is about 200 mm or more, big sagebrush is the characteristic plant, but low sagebrush has replaced it on some soils. Thurber needlegrass, bluebunch wheatgrass (scarce on drier sites), basin wildrye, squirreltail, Sandberg bluegrass, forbs, spiny hopsage, and Douglas rabbitbrush are common associated plants. Locally important are Idaho fescue and snowberry on sites where moisture is favorable, Utah juniper in a few high, rocky locations, and Indian ricegrass and needleandthread on sandy soils. Shadscale and bud sagebrush associated with Indian ricegrass and squirreltail are dominant on the drier sites. Black greasewood, basin wildrye, and Nuttall saltbush are locally important on some low terraces and flood plains. Winterfat is prevalent in some places.

25—Owyhee High Plateau

Idaho, Nevada, and Oregon

73,050 km² (28,210 mi²)

Land use: About three-fourths of this area is federally owned. Most of the remainder is in farms and ranches. Livestock production on rangelands is the main agricultural activity. Tracts in valleys, making up 2 or 3 percent of the total area, are irrigated and used for producing grain and forage for livestock. Small acreages in Idaho are dry-farmed to wheat. Open forests on high mountain slopes are grazed by livestock and wildlife.

Elevation and topography: Elevation ranges from 1,400 to 2,300 m on rolling plateaus and in gently sloping basins, but on some steep mountains it is more than 3,000 m. Steep north-south-trending mountain ranges are separated by broad basins filled with alluvium.

Climate: *Average annual precipitation*—200 to 400 mm in most of the area, but as much as 750 mm on mountain slopes. Precipitation is evenly distributed throughout the year, but it is low from midsummer to early in autumn. *Average annual temperature*—6 to 8°C. *Average freeze-free period*—90 to 120 days, decreasing with elevation; less than 60 days on high mountains.

Water: The supply of water from precipitation and streamflow is small and unreliable, except along the Owyhee, Bruneau, and Humboldt Rivers. Streamflow depends largely on accumulated snow on the higher mountains. Except in alluvial deposits along large streams, ground-water supplies are small and little used. Precipitation is adequate for dry farming on a few acreages of deep soils in Idaho.

Soils: Most of the soils are Xerolls. They are deep to shallow, medium textured to fine textured soils. They have a mesic, frigid, or cryic temperature regime, depending mostly on elevation. Argixerolls (Gem and Gabica series) and Haploxerolls (Bakeoven and Lickskillet series) are on the plateaus. Durixerolls (Donna and Stampede series) are in valleys at an elevation above 1,700 m. Haplargids (Nannyton series), Camborthids (Orovada series), and Durargids (Cherry Springs series) are on alluvial fans and terraces in valleys at an elevation below 1,700 m. Poorly drained Haplaquolls (Humboldt series) are on flood plains of the few major streams. Argixerolls (Kanlee, Chen, and Ramires series) and Cryoborolls (Harmehl and Mosquet series) are on mountains.

Potential natural vegetation: This area supports shrub-grass vegetation characterized by big sagebrush or low sagebrush and by bluebunch wheatgrass, western wheatgrass, or Idaho fescue. Other important plants are Sandberg bluegrass, foxtail wheatgrass, penstemon, phlox, milkvetch, lupine, aster, and rabbitbrush. On the high plateaus are juniper and curlleaf mountainmahogany and an understory predominantly of snowberry and ceanothus. Conifers, aspen, and very large mountainmahogany are in the Ruby Range and Jarbridge Mountains. The conifers include whitebark pine, limber pine, Engelmann spruce, subalpine fir, and bristlecone pine.

26—Carson Basin and Mountains

California and Nevada
23,960 km² (9,250 mi²)

Land use: Nearly three-fourths of this area is federally owned. Most of the remainder is used for farms, ranches, urban development, industrial enterprises, and transportation. Grazing of livestock on native grasses and shrubs is the principal agricultural activity. About 2 percent of the total area, principally in valleys along major streams, is irrigated, and hay, grain, and tame pasture and some onions, potatoes, and garlic are the crops grown. About 10 percent of the area on mountain slopes is woodland. Land formerly used for farming is being converted to urban uses. Controlling erosion on uplands and efficient use of available water resources are concerns of management.

Elevation and topography: Elevation ranges from 1,200 to 2,000 m in valleys, but mountain crests are as high as 4,000 m. Steeply sloping, north-south-trending mountain ranges are separated by broad valleys and basins.

Climate: *Average annual precipitation*—125 to 375 mm in most of the area but as much as 500 mm on mountain slopes. Precipitation is mostly snow in winter, but some rain falls in spring and in autumn. Summers are dry. *Average annual temperature*—4

to 10°C. *Average freeze-free period*—60 to 130 days, decreasing with elevation.

Water: The low precipitation in the valleys provides little water, but a few large rivers that have their source in high mountains outside the area supply water for irrigation and other uses along the course of the rivers. Reservoirs used principally for storing irrigation water include Washoe Lake, Topaz Lake, and Weber Reservoir. Ground water available in limited quantities in valley fill is being rapidly developed for urban, industrial, and agricultural uses.

Soils: The dominant soils are Argids, Orthids, Aquolls, Psamments, and Xerolls. Soils in the valleys have a mesic temperature regime and those in the higher mountains a frigid or cryic temperature regime. They have a mixed or montmorillonitic mineralogy. Soils in this area formed principally in mixed parent materials. Durargids (Reno and Indian Creek series), Haplargids (Washoe and Greenbrae series), Natrargids (Godecke series), Camborthids (Haybourne series), and Torripsamments (Toll series) are on alluvial fans, stream terraces, and flood plains. Haplaquolls (Bishop and Ophir series), Haploxerolls (Henningsen and East Fork series), and Nadurargids (Dangberg series) are on wet flood plains and terraces. Haploxerolls (Tarloc and Sutro series) and Argixerolls (Nosrac and Deven series) and areas of rock outcrop are on mountain slopes.

Potential natural vegetation: This area supports shrub-grass vegetation characterized by big sagebrush, but on some soils low sagebrush has replaced big sagebrush. Antelope bitterbrush, squirreltail, desert needlegrass, Thurber needlegrass, and Indian ricegrass are important associated plants. Green ephedra, Sandberg bluegrass, Anderson peachbrush, and several forb species also are common. Juniper-pinyon woodland is typical on mountain slopes. Jeffery pine, lodgepole pine, California red fir, white fir, and manzanita grow on the highest mountain slopes. Shadscale is the typical plant in the drier parts of the area. Sedges, rushes, and moisture-loving grasses grow on the wettest parts of the wet flood plains and terraces. Basin wildrye, alkali sacaton, saltgrass, buffaloberry, black greasewood, and rubber rabbitbrush grow on drier sites that have a high salt concentration.

27—Fallon-Lovelock Area

Nevada
32,990 km² (12,740 mi²)

Land use: About four-fifths of this area is federally owned. Most of the remainder is used for farms and ranches and for some urban and transportation purposes. Much of the area is used for livestock grazing on range of native grasses and shrubs. About 1 to 2 percent of the area, mostly near Lovelock and Fallon,

is irrigated and intensively farmed. Hay, grain, tame pasture, corn silage, alfalfa seed, and small areas of melons are important crops. Improved drainage of cropland and pastureland, control of salinity, and efficient use of range vegetation and available water supplies are major concerns of management.

Elevation and topography: Elevation generally ranges from 1,000 to 1,800 m in valleys, but on some mountain peaks it is more than 2,400 m. North-south-trending mountain ranges are separated by broad valleys and basins. The few large rivers terminate in lakes and playas.

Climate: *Average annual precipitation*—100 to 250 mm in most of the area but as much as 450 mm on high mountain slopes. Precipitation is very low from summer to midautumn. *Average annual temperature*—7 to 13°C. *Average freeze-free period*—60 to 150 days, decreasing with elevation.

Water: Water for irrigation is obtained principally from the few large rivers in the area. Water is stored in the Lahontan and Ryepatch Reservoirs for irrigation of crops in the principal agricultural areas near Fallon and Lovelock. Precipitation is very low, and ground water is scarce and of poor quality in the major valleys. Limited supplies of good- to fair-quality ground water in some of the outlying valleys is being rapidly harnessed for irrigation. Pyramid and Walker Lakes are terminal lakes used principally for recreation.

Soils: The dominant soils are Argids, Orthids, Aquolls, Xerolls, Fluvents, Orthents, and Psamments. They have a mesic temperature regime (frigid on higher mountains) and a mixed or montmorillonitic mineralogy. They formed principally in mixed parent materials. Natrargids (Bango and Churchill series), Durorthids (Gardella and Hooten series), Camborthids (Unionville and Toulon series), Torriorthents (Ragtown and Swinger series), and Torripsamments (Stumble and Tepperary series) are on alluvial fans and lake terraces. Haplaquolls (Carson and Humboldt series), Haploxerolls (Dia and East Fork series), Xerofluvents (Fallon and Lahontan series), and Salorthids (Parran series) are on wet flood plains, in basins, and on stream and lake terraces. Shallow Torriorthents, shallow Haplargids, Argixerolls, and Haploxerolls are on mountain slopes.

Potential natural vegetation: This area supports desert shrub vegetation. Shadscale is widespread. It is mixed with Bailey greasewood on uplands and with black greasewood and seepweed on lower sites. Grasses are generally sparse, although Indian ricegrass is prominent on sandy soils. Fourwing saltbush, winterfat, spiny hopsage, wolfberry, ephedra, dalea, and bud sagebrush are common shrubs. Basin wildrye, creeping wildrye, alkali sacaton, saltgrass, black greasewood, rubber rabbitbrush, and big saltbush are important plants. A few tule marshes support cattail, bulrushes,

sedges, and rushes. Big sagebrush, along with scattered Utah juniper and singleleaf pinyon, on some shallow soils is associated with Thurber needlegrass, basin wildrye, Sandberg bluegrass, and squirreltail on some higher alluvial fans and mountain slopes.

28A—Great Salt Lake Area

Idaho, Nevada, and Utah

94,260 km² (36,390 mi²)

Land use: More than 75 percent of this area is federally owned, large tracts of which are used for training and testing purposes by the Armed Forces and the Nuclear Regulatory Commission. A large area west and southwest of Great Salt Lake is a salty playa. The remainder is in farms and ranches. Livestock production on range is the principal agricultural activity in the west. The production of desert shrubs and grasses is very low. In most of the area, the extent of the livestock industry is determined largely by the amount of hay, pasture, and grain that can be produced under irrigation from the small local water supplies. About 5 percent of the area is irrigated cropland used for growing alfalfa, grain, sugar beets, vegetables, and fruits. About 5 percent is used for dryland wheat. Concerns of management include efficient use of range vegetation and limited water supplies, control of erosion in critical areas, and efficient use of irrigation water.

Elevation and topography: Elevation ranges from 1,200 to 2,000 m in the basins and from 2,000 to 3,400 m in the mountains. Nearly level basins bordered by long, gently sloping alluvial fans are between widely separated north-south-trending, steep mountain ranges.

Climate: *Average annual precipitation*—125 to 500 mm. The driest period is from midsummer to early autumn. *Average annual temperature*—7 to 13°C. *Average freeze-free period*—60 to 160 days, decreasing with elevation.

Water: Water is scarce. Both surface water and ground water are used for irrigation. For the most part, streams are small and intermittent and depend on sources in the higher mountains. Use of deep wells is limited by the high cost. Shallow wells are unreliable in flow, and the water commonly contains large amounts of salt.

Soils: The dominant soils in valleys are Orthents, Fluvents, Aquents, Aquolls, Orthids, and Argids, which have a mesic temperature regime. The dominant soils on mountain slopes are Xerolls, Ustalfs, and Xeralfs, which have a frigid or cryic temperature regime. Mineralogy is mixed, montmorillonitic, or carbonatic. The soils formed in mixed parent materials, mostly lacustrine sediments. The well drained, deep Torriorthents (Heist, Pomat, and Yuba series), Torrifluvents (Quaker, Redfield, and Sigurd series), and Torripsamments (Yenrab series) are on alluvial

fans, flood plains, and other recent surfaces. Haplaquolls (Provo series), Fluvaquents (Poganeab series), Salorthids (Cache and Saltair series), Natraquolls (Airport series), Natrustalfs (Leland, Harrisville, and Jordan series) and Calciaquolls (Chipman, Logan, and Warm Springs series) are on wet flood plains and basin surfaces. Deep Haplargids (Decca, Hansel, and Hoyer series), Natrargids (Mellor, Antelope Springs, and Uvada series), Calciorthids (Hiko Peak, Escalante, and Sanpete series), and Paleorthids (Neola and Denmark series) are on older valley surfaces. Haploxerolls (Kearns, Kidman, and Lakewin series), Palexerolls (Pavant, May Day, and Paice series), Calcixerolls (Pleasant Grove, Welby, and Pharo series), and Argixerolls (Bingham, Parleys, and Timpanogos series) are on lake terraces and alluvial fans.

Potential natural vegetation: This area supports desert shrub, shrub-grass, and woodland vegetation. In places where precipitation is less than about 200 mm, the soils support shadscale, winterfat, black sagebrush, and associated grasses such as Indian ricegrass and squirreltail. Greasewood and Nuttall saltbush grow on soils having a high salt or sodium content. In places where precipitation is 200 to 300 mm, the soils support big sagebrush, shadscale, winterfat, and associated grasses such as bluebunch wheatgrass, Indian ricegrass, and bluegrasses. In places where precipitation is more than 300 mm, the soils support Utah juniper, singleleaf pinyon, big sagebrush, bluebunch wheatgrass, bluegrasses, and needleandthread. A large nearly barren area west of Great Salt Lake has a very sparse cover of pickleweed, sapphire eriastrum, seepweed, and greasewood.

28B—Central Nevada Basin and Range

Nevada and Utah
78,150 km² (30,170 mi²)

Land use: More than 90 percent of this area is federally owned. Most of the remainder is in farms and ranches. Livestock grazing on range of native grasses and shrubs is the principal agricultural activity. In most of the area, the extent of the livestock industry is determined largely by the amount of hay, pasture, and grain that can be produced under irrigation from the small local water supplies. The irrigated land makes up 1 percent or less of the total area. About 10 percent of the area on mountain slopes is pinyon-juniper woodland. Concerns of management include efficient use of range vegetation and limited water supplies and control of erosion in critical places.

Elevation and topography: Elevation ranges from 1,500 to 2,000 m in the valleys and basins and from 2,000 to 4,000 m in the mountains. Nearly level valleys and basins bordered by long, gently sloping to strongly sloping alluvial fans are between north-south-trending steep mountain ranges.

Climate: Average annual precipitation—125 to 625 mm, increasing with elevation. The driest period is from midsummer to midautumn. *Average annual temperature*—4 to 10°C. *Average freeze-free period*—60 to 120 days, decreasing with elevation.

Water: Water is scarce. Both surface water and ground water are used for irrigation. For the most part, streams are small and intermittent and depend on sources in the higher mountains. Ground water available in the valley fill is being rapidly harnessed for irrigation of crops. A few small reservoirs have been constructed throughout the area for storage of water for irrigation and recreation purposes.

Soils: The dominant soils in the valleys are Orthents, Fluvents, Aquolls, Orthids, and Argids, which have a mesic temperature regime. The dominant soils on mountain slopes are Xerolls and Borolls, which have a frigid and cryic temperature regime. Mineralogy is mixed, montmorillonitic, or carbonatic. Most of the soils formed in mixed parent materials but in the eastern part extensive areas of soils formed in parent materials derived from limestone and dolomite. Deep Torriorthents (Penoyer and Hayeston series), Torrifluvents (Bruffy and Fivemile series), and Torripsamments (Tipperary series) are on well drained alluvial fans, flood plains and other recent surfaces. Haplaquolls (Hussa and Settlemyer series), Xerofluvents (Orizaba and Diane series), and Salorthids (Vinsad and Parran series) are on wet flood plains and basin surfaces. Shallow to deep Haplargids (Penelas and Buster series), Durargids (Ratto and Deerlodge series), Camborthids (Kobeh and Orovada series), Durorthids (Rubymill and Umil series), Calciorthids (Tonkin and Holsine series) and Paleorthids (Bit and Denmark series) are on older valley surfaces. Shallow to deep Haploxerolls (Holtle and Alpha series), Palexerolls (Pamsdel series), Durixerolls (Nevu and Drewing series), Calcixerolls (Ansping series), Argixerolls (Belmill and Homestake series), Cryoborolls (Wilpar and Fairymill series), and Rendolls (Sheege and Urtah series) are on mountain slopes.

Potential natural vegetation: This area supports saltbush-greasewood, big sagebrush, and pinyon-juniper woodland vegetation in the progression from lowest to highest elevation and precipitation. Shadscale, in association with bud sagebrush, spiny hopsage, ephedra, winterfat, fourwing saltbush, Indian ricegrass, squirreltail, and galleta, characterizes the saltbush-greasewood type. With an increase in moisture, plants associated with shadscale are replaced by needlegrasses, bluegrasses, bluebunch or beardless wheatgrass, basin wildrye, and forbs. Bailey greasewood (in the west), black greasewood, and Nuttall saltbush are locally important on some sites. Big sagebrush and black sagebrush, which grow on soils shallow to an indurated pan or bedrock, are dominant. In the pinyon-juniper woodland, bitterbrush,

serviceberry, and snowberry grow in association with Utah juniper and singleleaf pinyon. At the highest elevations there are thickets of curlleaf mountainmahogany and small amounts of mixed conifer forest with limber, bristlecone, or ponderosa pine, Douglas-fir, or white fir. On bottom lands basin wildrye, creeping wildrye, alkali sacaton, wheatgrasses, bluegrasses, sedges, and rushes are typical. Black greasewood, rubber rabbitbrush, and big sagebrush grow on the drier sites. Inland saltgrass, alkali sacaton, black greasewood, rubber rabbitbrush, and big saltbush typify vegetation on strongly saline-alkali soils.

29—Southern Nevada Basin and Range

California, Nevada, and Utah
66,380 km² (25,630 mi²)

Land use: More than 90 percent of this area is federally owned, much of which is used for training and testing purposes by military forces and the Nuclear Regulatory Commission. Less than 1 percent of the area, mostly in the valleys, is irrigated. Much of the irrigated acreage is used for growing hay and grain for livestock. High mountain areas consist of pinyon-juniper woodland. Rangeland of native grasses and shrubs are grazed by livestock. Concerns of management include proper use of rangeland, control of erosion, and efficient use of scarce water supplies.

Elevation and topography: Elevation ranges from 600 to 1,700 m in valleys, but on some high mountain peaks it is more than 2,400 m. The north-south-trending, steep mountains are separated by broad valleys bordered by sloping fans and terraces.

Climate: *Average annual precipitation*—Mainly 75 to 300 mm but as much as 375 mm on mountain slopes. Summers are dry, but sporadic storms are common in July and in August. *Average annual temperature*—11 to 16°C, decreasing with elevation. *Average freeze-free period*—60 to 200 days, decreasing with elevation.

Water: Precipitation is sparse. Streamflow supplies only a small amount of water for irrigation. Ground water is scarce but is being rapidly developed. In California, most of the water is controlled by Los Angeles and is not available for local use.

Soils: The dominant soils are Orthents, Psamments, Orthids, Argids, and Xerolls. They have a thermic, mesic, or frigid temperature regime, depending mostly on elevation, and a mixed or montmorillonitic mineralogy. Some Aquolls are in the valleys. Torriorthents (Fand and Penoyer series) and Torripsamments (Stumble and Sundown series) are on recent alluvial fans and terraces. Shallow to deep Camborthids (Mina series), Durorthids (Pharoc and Timper series), Naduargids (Timpahute and Monte Cristo series), Natrargids (Nyala series), Calciorthids (Aysees series), and Paleorthids (Crystal Springs and Sieroccliff

series) are on older alluvial fans and terraces and in valley-fill deposits. Torripsamments (Theriot and Pintwater series), Durixerolls (Decan and Vil series), Haploxerolls (Cedaran series), and Argixerolls (Pioche and Itca series) are in the mountains.

Potential natural vegetation: This area supports desert shrub vegetation. The major vegetation is saltbush-greasewood. Shadscale is widespread. It is associated with bud sagebrush, Bailey greasewood (in the west), gray molly kochia, spiny hopsage, wolfberry, ephedra, dalea, fourwing saltbush, winterfat, horsebrushes, galleta, and Indian ricegrass. Locally (in warmer parts), shadscale is associated with creosotebush, white bursage, spiny menodora, Joshua-tree, and blackbrush. Black greasewood is dominant on low-lying saline-alkali soils. Big sagebrush and black sagebrush grow on soils that have an indurated pan or bedrock near the surface and are associated with Indian ricegrass and galleta in cooler parts of the area. Pinyon-juniper woodland is prevalent in the mountains. Associated plants include black sagebrush, big sagebrush, blackbrush, bitterbrush, cliffrose, and other shrubs and a variety of grasses and forbs.

30—Sonoran Basin and Range

Arizona, California, and Nevada
194,030 km² (74,910 mi²)

Land use: About four-fifths of this area is federally owned. Much of the remainder is owned by local governments. Most of the land has a cover of desert vegetation. The area is used only locally for grazing because of the low forage production and the lack of water for livestock. On sites intensively used for recreation, especially where motorcycles and off-road vehicles are driven, the hazards of wind and water erosion are severe.

Elevation and topography: Elevation ranges from 100 m below sea level to 1,200 m above sea level in valleys and basins, but on some mountain ranges it is 3,400 m. Broad basins, valleys, and old lake beds make up most of the area, but widely spaced, north-south-trending mountains are throughout.

Climate: *Average annual precipitation*—50 to 250 mm in valleys but as much as 625 mm on mountain slopes. Precipitation is fairly evenly distributed throughout the year. *Average annual temperature*—16 to 24°C but as low as 10°C in the mountains. *Average freeze-free period*—Generally 240 days, but it is much shorter on the higher mountains and as long as 320 days in the south.

Water: Water is scarce. Irrigation water for agriculture is obtained almost entirely from the Colorado and Mojave Rivers. Some irrigation water is obtained from large springs in Nevada and from wells in Nevada and in California.

Soils: The dominant soils are Orthents, Psamments, Fluvents, Orthids, and Argids. Most of these soils

have a thermic temperature regime and an aridic moisture regime. A few have a hyperthermic or a mesic temperature regime. Torripsamments (Cajon, Pintura, Toquerville, and Rositas series), Torrifluvents (Coachella, Tobler, Hantz, Leeds, and Vint series), Salorthids (Land series), and Torriorthents (Isom and Ivins series) are in basins and valleys and on flood plains. Haplargids (Chuckwalla, Mohave, Renbac, and Bitter Springs series), Paleorthids (Las Vegas, Cave, Harrisburg, and Winkel series), Paleargids (Domino and Bermesa series), and Calciorthids (Hobog, Laverkin, Nickel, Sunrise, and Nikey series) are on older alluvial fans and terraces. Shallow Torriorthents (Cellar, House Mountain, Retriever, and St. Thomas series), shallow Haplustolls (Virgin Peak series), shallow Camborthids (Pulsipher series), and Torripsamments (Moapa series) are in mountainous areas.

Potential natural vegetation: This area supports thin stands of desert vegetation. Bursage, Joshua-tree, juniper, yucca, cactus, creosotebush, and Mormon-tea are major species. Numerous annual forbs and grasses grow during years of favorable moisture. Saltbush, saltgrass, alkali sacaton, and iodinebush grow on the alkali flats. Indian ricegrass, Joshua-tree, desert needlegrass, and galleta grow on sandy soils.

31—Imperial Valley

California

9,420 km² (3,640 mi²)

Land use: Intensive irrigated agriculture is practiced in this area. Citrus fruit, dates, grapes, sugar beets, many kinds of vegetables, small grains, flaxseed, hay, and tame pasture grasses are grown. Many livestock are fattened each year in feedlots. Non-irrigated land is in desert vegetation that has only slight value as range. Maintaining a favorable salinity status in the root zone is a major concern of management. Rainfall is too low to leach salts from the soils, so all leaching must be accomplished with the use of irrigation water.

Elevation and topography: Elevation ranges from 50 m below sea level to 200 m above sea level. This nearly level plain is broken by scattered steep-sided valleys and steep mesas.

Climate: *Average annual precipitation*—50 to 100 mm. *Average annual temperature*—21 to 24°C. *Average freeze-free period*—280 to 350 days.

Water: Almost all water for agriculture comes from the Colorado River, but wells provide irrigation water locally.

Soils: The dominant soils are Fluvents, Orthents, and Psamments. They are very deep and have a hyperthermic temperature regime and an aridic moisture regime. Coarse to moderately fine textured Torrifluvents (Coachella and Glenbar series), coarse to fine textured Torriorthents (Carrizo, Superstition,

and Imperial series), and coarse textured Torripsamments (Rositas and Myoma series) formed in recent alluvium and lacustrine deposits of the Colorado River.

Potential natural vegetation: This area supports sparse stands of desert vegetation. Mesquite, arrowweed, yucca, saltcedar, and cactus are dominant species. Numerous annual forbs and grasses grow during years of favorable moisture.

32—Northern Intermountain Desertic Basins

Montana and Wyoming

21,210 km² (8,190 mi²)

Land use: More than one-half of this area is federally owned. The remainder is in farms and ranches. Most of the land is used for grazing. The range consists of desert shrubs and short grasses. About 5 percent of the area is irrigated. Most of the acreage is planted to alfalfa and other feed crops, but dry beans, malt barleys, sugar beets, and corn are important cash crops.

Elevation and topography: Elevation ranges from 1,100 to 1,800 m. Piedmont plains and pediments slope from the mountains to the stream terraces of the Wind-Big Horn River system. In some places the plains are eroded to the clay shale bedrock, and there are areas of badland.

Climate: *Average annual precipitation*—125 to 225 mm. Maximum precipitation is in spring and in fall. *Average annual temperature*—About 7°C. *Average freeze-free period*—120 to 140 days.

Water: The low and erratic precipitation provides only a small amount of water. The Wind-Big Horn River and its tributaries bring irrigation water into the area from the bordering mountains. Deep artesian wells provide water for irrigation on the eastern side of the Big Horn Basin.

Soils: The dominant soils are Argids. They are moderately deep to very deep and moderately fine textured. These soils have a mesic temperature regime, an aridic moisture regime, mixed mineralogy, and an argillic horizon. Haplargids (Griffy and Saddle series) are on piedmont plains and pediments over clay shale and sandstone. Torriorthents (Persayo series) and areas of rock outcrop are on dissected slopes. Torrifluvents (Youngston and Havre series) and Torriorthents (Apron series) are on recent alluvial fans and flood plains. Natrargids (Meeteetse series) are on alkaline clay shale.

Potential natural vegetation: This area supports shrub-grass vegetation. Big sagebrush, gardner saltbush, rhizomatous wheatgrasses, Indian ricegrass, and needleandthread are dominant species. Black sage, gardner saltbush, and bluebunch wheatgrass are common on shallow soils on the uplands.

33—Semiarid Rocky Mountains

Wyoming

11,000 km² (4,250 mi²)

Land use: One-fourth or more of this area is federally owned. The remainder is in ranches. Most of the land is used for grazing. The range consists of desert shrubs and short grasses. Open woodland is at high elevations in some mountains. Small irrigated tracts in isolated valleys are used mainly for hay.

Elevation and topography: Elevation ranges from 1,800 to 3,100 m. Mountain ranges with steep slopes rise sharply from desert basins.

Climate: *Average annual precipitation*—250 to 400 mm. Maximum precipitation is in spring and early in summer. *Average annual temperature*—7°C. *Average freeze-free period*—Less than 120 days, decreasing with elevation.

Water: Water is scarce. The low precipitation, small and intermittent streamflow, and scarcity of ground water seriously limit water developments.

Soils: The dominant soils are Orthents. They are shallow to very deep and moderately coarse to moderately fine textured and have a frigid temperature regime, an aridic moisture regime, and mixed mineralogy. Torriorthents (Crownest series), Haplargids (Cotha series), and areas of rock outcrop are on upland slopes. Torriorthents (Delphill and Patent series) are on pediments and alluvial fans at the base of the slopes.

Potential natural vegetation: This area supports a grass-shrub vegetation. Columbia needlegrass, brome, rhizomatous wheatgrasses, and big sagebrush are the dominant species. Idaho fescue, Columbia needlegrass, black sagebrush, and scattered Rocky Mountain juniper are dominant on shallow soils. Lodgepole pine, ponderosa pine, and limber pine grow on upper mountain slopes. Clumps of aspen are in some moist pockets.

34—Central Desertic Basins, Mountains, and Plateaus

Colorado, Wyoming, and Utah

122,350 km² (47,230 mi²)

Land use: Slightly more than one-half of this area is federally owned. The remainder is in ranches. Most of the land is used for sheep and cattle grazing. The range consists of desert shrubs and short grasses. Between 2 and 5 percent of the land, mostly along the few large streams, is irrigated. Hay and pasture are grown under irrigation.

Elevation and topography: Elevation ranges from 1,900 to 2,200 m. Alluvial fans, piedmont plains, and pediments slope from the surrounding mountains to form broad intermountain basins.

Climate: *Average annual precipitation*—175 to 300 mm. Maximum precipitation is in spring and fall.

Average annual temperature—4 to 11°C. *Average freeze-free period*—80 to 100 days.

Water: Water is scarce. Irrigation water is available along the few large streams that bring water into the area from adjoining mountains. Ground-water supplies are meager and little developed.

Soils: The dominant soils are Orthents. They are shallow to very deep and medium textured to fine textured and have a frigid temperature regime, an aridic moisture regime, and mixed or montmorillonitic mineralogy. Torriorthents (Patent and Garsid series) and Haplargids (Diamondville and Fraddle series) are on piedmont plains, alluvial fans, and pediments. Torrifluvents are on flood plains. Shallow Torriorthents (Blazon and Haterton series) are on rough, broken slopes. Some Torriorthents (Elkol series) and Torrifluvents (Laney series) have a high content of exchangeable sodium.

Potential natural vegetation: This area supports grass-shrub vegetation. Rhizomatous wheatgrasses, needleandthread, Indian ricegrass, and big sagebrush are the dominant species. Bluebunch wheatgrass, western wheatgrass, big sagebrush, and scattered Rocky Mountain juniper commonly grow on shallow soils on the uplands.

35—Colorado and Green River Plateaus

Arizona, Colorado, and Utah

123,350 km² (47,630 mi²)

Land use: Approximately 90 percent of this area is rangeland. The range is grazed by sheep and cattle. About 1 percent of the area, along the valleys of the major streams, is irrigated cropland. Alfalfa, small grains for hay, and corn for silage are the chief crops. About 1 percent of the area in scattered small tracts on Indian reservations is dry-farmed, and corn is the chief crop. About 8 percent is juniper and pinyon-juniper woodland. Firewood and pinyon nuts are products of this woodland, which is also grazed by cattle and sheep. If the areas are overgrazed, juniper invades the grassland. Severe gullying and the lack of a dependable water supply are land use problems.

Elevation and topography: In most places, elevation is 1,300 to 1,500 m. Mt. Trumbull, on the north rim of the Grand Canyon, however, is 2,400 m high, and the Navajo Mountain, on the Utah-Arizona state line, is 3,200 m. In general, the surface consists of gently sloping to strongly sloping plains. Volcanic plugs that rise abruptly above the plains, steep scarps, or deeply incised canyons interrupt the plain surface. The Painted Desert, Vermillion and Echo Cliffs, Glen Canyon Recreational Area, and Canyonlands National Park are included.

Climate: *Average annual precipitation*—150 mm or less to about 350 mm at high elevations. About half of the precipitation falls from July through September;

April, May, and June are the driest months. Light snow falls in winter. *Average annual temperature*—8 to 13°C. *Average freeze-free period*—110 to 180 days.

Water: Water is scarce throughout the area. The Little Colorado River drains the largest segment of the area, but its flow is intermittent. Water is stored in small reservoirs for irrigation purposes, but supplies are often inadequate. Some irrigation water is obtained from erratic streamflow and in some localities from deep wells. Water from shallow wells is mostly highly mineralized and inadequate in quantity.

Soils: The dominant soils are Orthents, Fluvents, and Psamments. They have a mesic temperature regime and an aridic moisture regime. Torriorthents (Moenkopie, Claysprings, Aneth, and Winona series) and areas of rock outcrop are extensive. Large, actively eroded exposures of shale and sandstone (badland) include the Painted Desert and the Petrified Forest National Park. Deep, nearly level to gently sloping, well drained, moderately coarse textured to fine textured Torrifluvents (Trail, Ives, Tours, Jocity, and Navajo series) are on flood plains and low fans. Torripsamments (Sheppard series), sandy Camborthids, and Calciorthids (Mota and Whit series) are in the north.

Potential natural vegetation: This area supports desert shrub and woodland vegetation. At high elevations, pinyon-juniper woodland and sagebrush have an understory of galleta, blue grama, black grama, and western wheatgrass. Galleta grass, alkali sacaton, Indian ricegrass, bottlebrush squirreltail, and needlegrasses intermixed with fourwing saltbush and winterfat grow at lower elevations. Greasewood and shadscale are part of the plant community on salty soils. At low elevations, blackbrush is dominant on soils that formed in parent materials of sandstone and limestone.

36—New Mexico and Arizona Plateaus and Mesas

Arizona and New Mexico
69,130 km² (26,690 mi²)

Land use: About one-fifth of this area is federally owned. An equal or larger proportion is set aside as Indian reservations. The remainder is in farms, ranches, or other private holdings. Most of the privately and publicly owned land is used for range. Less than 1 percent of the total area is cropland used for growing irrigated hay and pasture or for dry-farmed grain and hay.

Elevation and topography: Elevation ranges from 1,500 to 2,300 m, but in a few isolated mountains it is more than 2,600 m. These plateaus and mesas have gentle slopes, but precipitous slopes are along valley walls and edges of the mesas.

Climate: *Average annual precipitation*—250 to 325 mm in most of the area but 375 mm at higher

elevations. About two-thirds of the precipitation falls from midsummer to early in autumn. *Average annual temperature*—9 to 12°C. *Average freeze-free period*—120 to 180 days.

Water: Water is scarce because of the low precipitation and sparse streamflow. A small amount of water is available for irrigation along the major streams that flow into the area from surrounding mountains. Navajo Lake is near the northern border.

Soils: Most of the soils are Argids and Orthents. They are well drained and fine textured to medium textured and have a mesic temperature regime, an aridic moisture regime, and mixed mineralogy. The nearly level to gently sloping Haplargids (Penistaja, Clovis, Fernando, Pankey, Silver, and Sedillo series) are on uplands, and the gently sloping to strongly sloping Haplargids are on piedmonts at the base of mountains. The gently sloping to strongly sloping Calciorthids (Harvey, Little, and Las Lucas series) are on alluvial fans, and the gently sloping to rolling Calciorthids are on shale-controlled uplands. Shallow, gently sloping to moderately steep Torriorthents (Travessilla series) are on sandstone-controlled uplands. The deep, gently sloping to hilly Torriorthents (Pojoaque and Chilton series) are on dissected uplands, and the deep, strongly sloping to rolling Torriorthents are on alluvial fans. Shallow Argistolls (Cabezón, Encierro, and Bernal series) are on uplands of basalt and sedimentary rocks. Haplustolls (Manzano and Prewitt series) and Torrifluvents (Lohmiller series) are on the stream deposits of valley floors and flood plains.

Potential natural vegetation: Most of this area supports grassland vegetation. Indian ricegrass, blue grama, dropseed, and galleta are the major species. Alkali sacaton, fourwing saltbush, winterfat, and rabbitbrush grow in the valleys between mesas. Pinyon-juniper woodland is at the higher elevations and also on shallow soils and escarpments. The understory is western wheatgrass, galleta, sideoats grama and, in some places, big sagebrush.

37—San Juan River Valley Mesas and Plateaus

Arizona, Colorado, New Mexico, and Utah
13,350 km² (5,160 mi²)

Land use: About one-half of this area is in range of desert shrubs and short grasses. About 10 percent, mainly at higher elevations, is pinyon-juniper woodland that provides some grazing. About one-third of the area is federally owned, some of which is grazed. About 2 percent is irrigated cropland in narrow discontinuous bands along the San Juan River and its larger tributaries, and plans call for the irrigation of an additional 4 percent. Grain and hay grown for livestock feed are the main crops, but fruits, vegetables, and other cash crops are also grown.

Elevation and topography: Elevation ranges from 1,500 to 2,000 m. Gently sloping broad valleys and plains are bordered by deeply dissected bands of steep slopes and sharp local relief. Margins of mesas and a few isolated low mountain ranges are also steeply sloping.

Climate: *Average annual precipitation*—175 to 250 mm. About one-half of the precipitation falls from midsummer to early in autumn. *Average annual temperature*—10 to 12°C. *Average freeze-free period*—140 to 165 days.

Water: The low precipitation and intermittent stream-flow provide a small amount of water for agriculture. A few major streams supply water for irrigation. Water from Navajo Lake is to be used for an irrigation project planned for the area. Ground water is scarce, of poor quality, and mostly untapped.

Soils: Most of the soils are Orthents. They are well drained and medium textured and have a mesic temperature regime, an aridic moisture regime, and mixed mineralogy. Shallow, gently sloping to rolling Torriorthents (Farb and Chiptea series) are on dissected, shale- and sandstone-controlled uplands. Nearly level to gently sloping, loamy, deep Torriorthents (Turley, Fruitland, and Azfield series), Torrifluvents (Billings series), and Ustifluvents (Werlow series) are on side slopes and valley floors. Nearly level to gently sloping, loamy, deep Haplargids (Doak and Shiprock series) and Camborthids (Kinnear and Avalon series) are on mesa tops. Sandy, deep, undulating to gently rolling Torripsamments (Sheppard series) are on dunelike uplands. Areas of badland and rock outcrop are conspicuous on the dissected uplands and on valley walls.

Potential natural vegetation: This area supports desert shrub vegetation. Indian ricegrass, big sagebrush, fourwing saltbush, and galleta are major species. Shadscale, greasewood, alkali sacaton, and fourwing saltbush are on the bottom lands. Pinyon-juniper woodland, along with mountainmahogany, western wheatgrass, and galleta are at higher elevations. Most of the western part of the area is grassland on which Indian ricegrass, alkali sacaton, and sand dropseed are dominant.

39—Arizona and New Mexico Mountains

Arizona, Colorado, New Mexico, and Utah

111,140 km² (42,910 mi²)

Land use: Most of this area is covered with timber of commercial quality, including an extensive stand of ponderosa pine. Lumbering is an important industry. This area, which constitutes the primary watershed for much of Arizona, contains numerous lakes and live streams and an abundance of wildlife. Recreation, including hiking, camping, fishing, hunting, and skiing, is an important land use. At higher elevations

the timbered areas grade to stands of pinyon and juniper, and at lower elevations they grade to chaparral and grassland. The woodland consists of relatively open stands; the understory is grass and browse. The woodland is used as range for summer grazing of cattle and sheep. Irrigated cropland is inextensive along the narrow bottoms of the live streams. Corn, alfalfa, small grains, and vegetables are the major crops and are used mostly on the farms where they are produced. In Utah, wheat and pinto beans are produced on dry cropland. Concerns of management include maintaining proper grazing distribution, controlling juniper that invades rangeland, and controlling gullying. Wind and water erosion are hazards on dry cropland.

Elevation and topography: In most places, elevation ranges from 1,400 to 2,400 m, but it is 3,500 m on Baldy Mountain and 3,800 m on Humphreys Peak. This area is mostly very hilly and mountainous, but an upland plateau is dissected by many deep canyons.

Climate: *Average annual precipitation*—275 to 900 mm, increasing with elevation. *Average annual temperature*—5 to 15°C. In timbered areas at higher elevations the average is 7°C, and at lower elevations it is 10°C. *Average freeze-free period*—less than 70 days at higher elevations to 170 days at lower elevations, averaging about 115 days.

Water: This MLRA supplies water for much of the adjoining irrigated areas. Because more than one-half of the annual precipitation occurs in winter, there is a general deficiency of moisture during the growing season. Several of the larger streams and a few of their larger tributaries maintain a yearlong flow. Much of this water is stored in reservoirs near or below the southern edge of the area and is used for irrigation and for municipal water supplies in the Central Arizona Basin and Range major land resource area. Small natural and artificial lakes at higher elevations are used for fishing and other recreation. Annual runoff into all reservoirs is highly variable, and most of the smaller lakes and reservoirs are dry in some years. Ground water is limited and usually occurs at great depth.

Soils: The dominant soils are Borolls, Boralfs, Ustolls, Ustalfs, Orthents, and Orthids. They have a cryic, frigid, or mesic temperature regime, depending mainly on elevation. Argiborolls (Broliar, Sponseller, and Ess series) and Cryoborolls (Gordo and Tatiyee series) at the higher elevations formed in intrusive and extrusive volcanic materials, dominantly basalt. At lower elevations, Eutroboralfs (Dandrea, McVickers, Overgaard, and Hogg series), Ustorthents (Mirabal, Lockerby, and Telephone series), Haplustalfs (Jacks and Elledge series), Argiustolls (Showlow, Monticello, Northdale, and Roundtop series), Haplustolls (Tortugas and Ackman series), Calciorthids (Cibeque and Hovenweep series), and Glossoboralfs (Soldier series)

overlie schist, sandstone, shale, limestone, and old alluvium.

Potential natural vegetation: This area supports alpine vegetation, conifer forests, chaparral, and grasses because of the broad elevation range. Such cushion plants as moss campion, kobresia, alpine timothy, and many low-growing forbs grow above timberline. Spruce-fir woodland characterizes the area below timberline. Aspen grows on sites that have not been disturbed by past fires. The understory includes Thurber fescue, brome, bluegrasses, mountain muhly, Arizona fescue, lupine, aspen peavine, penstemons, and daisies. The major part of the area is a vast ponderosa pine forest. Common understory plants include bromes, junegrass, pine dropseed, wheatgrasses, mountain muhly, blue grama, sedges, and snowberry. Pinyon-juniper woodland is at an elevation below 2,100 m. The understory is blue grama, tobosa, sideoats grama, and western wheatgrass. Below an elevation of about 1,800 m, turbinella oak, mountainmahogany, hollyleaf buckthorn, ceanothus, and manzanita grow along with sideoats grama, blue grama, junegrass, longtongue muttongrass, squirreltail, and bluegrasses.

40—Central Arizona Basin and Range

Arizona

47,130 km² (18,200 mi²)

Land use: Most of this area is desert that affords limited grazing during seasons of favorable moisture. Land under irrigation is used for growing cotton, alfalfa, barley, and other small grains. In places where water supplies are favorable, lettuce, carrots, cabbage, cauliflower, melons, other market vegetables, and citrus are grown. Rapid urbanization around the larger communities is greatly reducing the acreage of cropland. Land use problems include declining water tables and accumulation of salt in soils used for crops. Efficiently using the short water supply is a chief concern of management.

Elevation and topography: Elevation ranges from 300 to 1,100 m, but in the mountains it is as high as 1,400 m. Many short, southeast-northwest-trending block-fault mountain ranges rise abruptly from the smooth or gently sloping valley floors. Valleys are filled to great depth with materials washed from the mountains.

Climate: *Average annual precipitation*—125 to 300 mm. Precipitation falls mainly from July to September and from December to March. Snowfall is rare except at higher elevations. *Average annual temperature*—18 to 22°C. *Average freeze-free period*—250 to 300 days.

Water: Water for irrigation is stored in a reservoir system on the Salt River. Some water for irrigation is pumped from deep wells. The water generally is of good quality, but the ground-water table is dropping.

No perennial streams originate or run through the area because the water of the larger drainages is impounded by reservoirs upstream from the cultivated lands.

Soils: The dominant soils are Orthids, Argids, Orthents, and Fluvents. They have a thermic and hyperthermic temperature regime and an aridic moisture regime. Shallow Camborthids (Lomitas series), Haplargids (Gachado and Lehmans series), Torriorthents (Cellar and House Mountain series), and areas of rock outcrop on hills and mountains make up about 50 percent of the area. Torrifluvents (Glenbar, Glendale, Gila, Gilman, Antho, Anthony, Vint, Vinton, Agua, Cashion, and Gadsden series) on low fans and flood plains are dominant in the valleys. Calciorthids (Laveen, Latene, Rillito, Rilloso, Coolidge, and Gunsight series), Haplargids (Mohall, Tremant, Pinamt, and Vecont series), Durorthids (Pinal series), Durargids (La Palma series), and Natrargids (Casa Grande series) also occur.

Potential natural vegetation: This area supports desert shrub vegetation. The giant saguaro cactus is a major species. Bursage, desert wolfberry, ocotillo, cholla, desert saltbush, mesquite, brittlebush, burroweed, pricklypear, desert broom, and creosotebush are dominant desert shrubs. Bush muhly, Arizona cottontop, threeawns, and fluffgrass are understory plants. Winter annuals grow in places, depending on the amount of winter precipitation. Joshua-tree and littleleaf paloverde mixed with some honey mesquite and an understory of Mormon-tea, pricklypear, cholla, ocotillo, desert saltbush, and such grasses as tridens, bush muhly, tobosa, Arizona cottontop, and desert needlegrass are on stony, rocky sites. At lower elevations, creosotebush, ironwood, mesquite, burroweed, and catclaw are associated with an understory of threeawns and annuals such as red fescue, bluegrasses, fiddleneck, indianwheat, globemallow, and filaree.

41—Southeastern Arizona Basin and Range

Arizona and New Mexico

45,560 km² (17,590 mi²)

Land use: Most of this area is used for grazing. Some land is under irrigation, and cotton, corn, alfalfa, small grains, and other farm crops are grown. In recent years, lettuce has been grown for the fall and spring markets. Many tracts of rangeland and cropland are subdivided for community development. The main concern of management on rangeland is controlling the distribution of grazing. (Invasion of brushy species and local gully erosion are symptoms of overgrazing.) Land use problems associated with cultivated land include declining water tables and a short supply of irrigation water.

Elevation and topography: Elevation ranges from 800 to 1,400 m in most places and from 1,500 m to 1,800 m in the mountains. On some peaks, however, elevation is 2,700 m, and on Mt. Graham in Arizona it is 3,300 m. This area consists of southeast-northwest-trending mountain ranges with relatively smooth valleys separating the mountains. In the vicinity of Wilcox Arizona, there is a closed basin, the bottom of which forms the Wilcox Playa.

Climate: *Average annual precipitation*—275 to 375 mm, but as much as 900 mm at the higher elevations. More than half of the precipitation falls during July, August, and September. Snow falls occasionally in winter. *Average annual temperature*—13 to 17°C. *Average freeze-free period*—150 to 250 days.

Water: None of the streams flow continuously, although they may have water in them for several months each year. There are no lakes or reservoirs of consequence. Water for irrigation generally is obtained by pumping ground water, and there has been a noticeable decrease in the ground-water level in the last several years. Water quality is generally satisfactory. Small artesian flows occur along parts of the San Pedro River.

Soils: The dominant soils are Orthents, Ustolls, Argids, and Fluvents. They have a thermic temperature regime and mostly an aridic moisture regime. Shallow Torriorthents (Cellar, House Mountain, and Tidwell series) and Haplustolls (Lampshire, Mabray, Witch, Faraway, Tortugas, and Barkerville series) and areas of rock outcrop on the hills and mountains make up approximately 40 percent of the area. In the valleys, Haplargids (White House, Bernardino, Sonoita, Caralampi, and Pinaleno series), soils having a high content of carbonates, including Calciustolls (Hathaway, Elfrida, Cogswell, and Kimbrough series), and Torrifluvents (Gila, Glendale, Anthony, Pima, Grabe, and Comoro series) are dominant. Other soils include Paleargids (Tubac series), Chromusterts (Bonita and Rimrock series), Natrustalfs (Crot series), Durorthids (Steward series), Natrargids (Gothard series), and Paleorthids (Cave series).

Potential natural vegetation: This area supports forest, savanna, and desert shrub vegetation. Pine-oak woodlands are at higher elevations. Ponderosa pine, Douglas-fir, live oak, New Mexico locust, Mexican pinyon, buckbrush, and manzanita grow with an understory of muhlys, bluegrasses, sedges, pine dropseed, and squirreltail. Evergreen woodland savannas are at intermediate elevations. Mexican blue oak, Emory oak, and turbinella oak are dominant species. Cone beardgrass, sideoats grama, blue grama, Texas bluestem, plains lovegrass, sprucetop grama, threeawns, and needlegrass characterize the understory. Whitethorn, soap tree yucca, fourwing saltbush, mesquite, and ocotillo grow on drier soils at lower

elevations. The understory consists of Rothrock grama, black grama, alkali sacaton, curly mesquite, plains bristlegrass, bush muhly, and lemongrass.

42—Southern Desertic Basins, Plains, and Mountains

New Mexico and Texas

115,470 km² (44,580 mi²)

Land use: About one-third of this area is federally owned. Most of the remainder is in farms, ranches, or other private holdings. The federal land is mainly in New Mexico. Two-thirds or more of the total area is in range of low carrying capacity. Less than 1 percent is irrigated. Cotton, cantaloupes, and vegetables are the principal crops. Grain sorghum, alfalfa, and other feed and forage crops are also grown.

Elevation and topography: Elevation ranges from 800 to 1,500 m in basins and valleys, but it is more than 2,600 m in the mountains. Broad desert basins and valleys are bordered by gently sloping to strongly sloping fans and terraces. Steep north-south-trending mountain ranges and many small mesas are in the western part.

Climate: *Average annual precipitation*—200 to 325 mm. Maximum precipitation is from midspring to midautumn. *Average annual temperature*—13 to 18°C. *Average freeze-free period*—200 to 240 days in most of the area but 180 days in the northern ends of the Pecos and Rio Grande valleys.

Water: Scarce surface water and low precipitation are severe limitations to use of the area for range. The Rio Grande and Pecos Rivers and a few of their larger tributaries are the only perennial streams. Water for irrigation generally is obtained from these rivers or from wells. Ground water in deep valley fill provides water for domestic use and for livestock and in places for some irrigation.

Soils: Most of the soils are Argids and Orthids. They are well drained and medium textured and have a thermic temperature regime, an aridic moisture regime, and mixed or carbonatic mineralogy. Deep and moderately deep Haplargids (Berino, Madurez, Mohave, Cacique, and Pyote series), Paleargids (Wickett and Douro series), and Calciorthids (Wink, Reaker, Hoban, Turney, Reagan, and Nickel series) are on uplands, piedmont plains, and dissected terraces. Shallow Haplargids (Lehmans series), shallow Calciorthids (Lozier series), Ustolls (Ector series), and Torriorthents (Holloman series) are on bedrock-controlled uplands. Shallow Paleorthids (Simona, Upton, Conger, Blakeney, Delnorte, and Tencee series) are on mesas, uplands, and terraces. Deep and moderately deep Gypsiorthids (Yesum and Reeves series) are in closed basins. Camborthids (Mimbres series), Natrargids (Hondale series), and Torrerts (Dalby and Verhalen series) are on basin floors.

Torrifluvents (Gila, Glendale, and Vinton series) are on the flood plains. Torripsamments (Bluepoint, Penwell, Kermit, and Pintura series) are on hummocky sandy uplands.

Potential natural vegetation: This area supports desert grass-shrub vegetation. Giant dropseed and mesa dropseed, along with scattered shrubs such as

sand sagebrush and yuccas, grow on the sandier soils. Creosotebush, tarbush, catclaw, and javalinabush are on gravelly, calcareous foot slopes. Giant sacaton, vine-mesquite, desertwillow, brickellbush, and mesquite grow in drainageways and depressions. Juniper, pinyon, scattered ponderosa pine, and Douglas-fir are on upper mountain slopes.

E—ROCKY MOUNTAIN RANGE AND FOREST REGION

597,250 km² (230,600 mi²)

Rugged mountains are the dominant feature of this region, but there are some broad valleys and remnants of high plateaus. The average annual precipitation ranges from 500 to 1,025 mm in much of the region, but it is less than 250 mm in some valleys and 1,275 mm or more on some of the mountain peaks. The average annual temperature is generally 4 to 7°C, but it ranges from 2 to 10°C. The freeze-free period is 100 to 140 days in most valleys and basins, but it is 40 days or less in the high mountains where frost occurs every month of the year. Some of the highest mountains are covered by glaciers, and the ground is permanently frozen. The freeze-free period on foothills in the southern part is as long as 160 days.

Ustolls, Ochrepts, and Ustalfs are the dominant soils in valleys and on lower mountain slopes. Ochrepts, Borolls, and Orthents are dominant on upper mountain slopes and crests. Orthents and areas of rock outcrop are extensive on steep mountain slopes, and Fluvents and Aquolls are in valleys.

Grazing is the leading land use in the valleys and in the mountains, but lumbering is important in some of the forested mountain areas. Use of the land for recreation is important throughout this region. Irrigation is practiced in some of the valleys and dryfarming in others. Grain and forage for livestock are the main crops. Beans, sugar beets, peas, and seed crops are also grown in places where soils, climate, and markets are favorable.

43—Northern Rocky Mountains

Idaho, Montana, Oregon, Washington, and Wyoming
282,650 km² (109,130 mi²)

Land use: Nearly all this area is federally owned and administered by the Forest Service, U.S. Department of Agriculture, and the Bureau of Land Management, Department of the Interior. Most of the privately owned land is controlled by large commercial timber companies. All the forested areas are used as wildlife habitat, for recreation and watershed, and for timber production. Meadows on the upper mountain slopes and crests above timberline provide summer grazing for livestock and big game animals. Mining is an important industry in Idaho and in western Montana. Dairy and livestock farms are important enterprises in the west. Less than 2 percent of the area is cropped. Forage, grain, peas, and a few other crops are grown in some valleys.

Elevation and topography: Elevation is mainly 400 to 2,400 m, but it is almost 3,000 m on some mountain peaks. Some areas in Montana and Wyoming are at an elevation of 2,100 to 3,000 m, and mountain peaks are almost 4,300 m. High mountains having steep slopes and sharp crests are cut by narrow valleys, most of which have steep gradients. Lakes are common, especially in glaciated areas.

Climate: *Average annual precipitation*—Mainly 625 to 1,525 mm, increasing with elevation, but almost 375 mm in the western part of the area and almost 2,550 mm in high mountains. Most of the precipitation during fall, winter, and spring is snow. Summers are dry. *Average annual temperature*—2 to 7°C in most of the area, but it is 8°C or more at low elevations. *Average freeze-free period*—45 to 120 days, decreasing with elevation, and as long as 140 days in low valleys of Washington. Frost occurs every month of

the year on high mountains; some peaks have a continuous cover of snow and ice.

Water: Moderate precipitation and many perennial streams and lakes provide ample water. Streams and reservoirs supply water to adjoining MLRA's for irrigation and other uses. Springs and shallow wells in the valleys provide water for domestic use and for livestock. Elsewhere, ground-water supplies are small and mostly untapped.

Soils: Most of the soils are Ochrepts and Andepts. They have a frigid or cryic temperature regime. Shallow to moderately deep, medium textured and moderately coarse textured Cryochrepts (Jughandle and Holloway series) and Xerochrepts (Waits and Moscow series) are on mountain slopes. Cryandepts (Huckleberry, Truefissure, and Coerock series) are on ridges with thin layers of volcanic ash. Stony Cryorthents (Tamely series) and areas of rock outcrop are on peaks and ridges above timberline. Detailed soil survey information is lacking in most of the area.

Potential natural vegetation: This area supports conifer forests. Forests of western white pine, ponderosa pine, lodgepole pine, western redcedar, western larch, hemlock, Douglas-fir, subalpine fir, and spruce are common. Alpine grasses, forbs, and shrubs and scattered stands of subalpine fir, spruce, and whitebark pine grow on high mountains of Montana and Wyoming.

44—Northern Rocky Mountain Valleys

Idaho, Montana, and Washington
32,320 km² (12,480 mi²)

Land use: Nearly all this area is in farms and ranches. As much as one-third of the land in some valleys is

irrigated. Potatoes, sugar beets, and peas are important cash crops, but a larger acreage is in hay, grain, and pasture for livestock feed. In places where precipitation is adequate, the land is dry-farmed to wheat. One-third to one-half of the area is range of native grasses and shrubs. Beef cattle and sheep are the principal livestock, but dairying is an important enterprise near the larger towns. Much of the area in northern Idaho is forested, and elsewhere many steep and stony soils are in woodland. These forests are of value to the lumber industry and are also grazed.

Elevation and topography: Elevation ranges from 600 to as much as 2,100 m; the highest is in southwestern Montana. The deep valleys bordered by mountains are mostly north-south trending. In the valleys, nearly level, broad flood plains are bordered by gently sloping to strongly sloping terraces and fans. In many places the valleys have been modified somewhat by glaciation, and in the north, lacustrine sediments cover much of the valley floors.

Climate: *Average annual precipitation*—300 to 400 mm in most of the area, less than 250 mm in Montana, and 850 mm in northern Idaho. Precipitation is fairly evenly distributed throughout fall, winter, and spring but is low in summer. Most of the precipitation in winter is snow. *Average annual temperature*—4 to 8°C. *Average freeze-free period*—100 to 120 days in much of the area, but it is 80 days or less at the highest elevations and 130 days or more at the lowest.

Water: Perennial streams flowing into the area from surrounding mountains are the principal source of water. The amount usually is adequate but depends on the snow accumulation in the mountains. Ground water is abundant in the deeper unconsolidated fill materials, and some is used for irrigation. Precipitation is adequate for some dryfarming at higher elevations and throughout the area in northern Idaho.

Soils: The dominant soils are mostly Orthids, Borolls, and Argids. They are medium textured to fine textured and mainly well drained and have a frigid or, at higher elevations, a cryic temperature regime. At the lower elevations, deep and moderately deep Calciorthids (Crago and Musselshell series), Haploborolls (Bitterroot and Grantsdale series), and Argiborolls (Martinsdale series) are on alluvial fans and terraces. Natrargids (Round Butte series) are on lacustrine fans and terraces, and Fluvents are on alluvial flood plains and low terraces. At the higher elevations, mostly deep, well drained to somewhat poorly drained Cryoborolls (Amsterdam, Bozeman, Bridger, and Gallatin series) are on alluvial terraces and fans, and Aquents and Aquepts are adjacent to drainageways and in undrained depressions.

Potential natural vegetation: This area supports conifer forests and grassland vegetation. Bluebunch

wheatgrass, rough fescue, Idaho fescue, and bearded wheatgrass are the major species of the grassland in the valleys and foothills. Douglas-fir, ponderosa pine, grand fir, western redcedar, western hemlock, pinegrass, common snowberry, mallow ninebark, and white spirea are the major forest species.

46—Northern Rocky Mountain Foothills

Montana and Wyoming

52,070 km² (20,110 mi²)

Land use: About one-fifth of this area is federally owned. The remainder is in farms and ranches. One-half or more of the area is range of short and mid grasses and some shrubs. Many of the valleys are irrigated, but they make up only 1 or 2 percent of the total area. Grain and forage for livestock are the main crops, but potatoes, sugar beets, peas, and some other crops are grown in the warmer valleys. About one-fifth of this area, mainly along the northeastern side, is dry-farmed to wheat. Some of the highest hills are forested.

Elevation and topography: Elevation ranges from 1,100 to 1,800 m in the north, increasing gradually to 1,800 or 2,400 m in the south and in central Wyoming. The rugged hills and low mountains are cut by many narrow valleys that have steep gradients. Broad flood plains and fans border a few of the major rivers.

Climate: *Average annual precipitation*—Mainly 300 to 500 mm, but it is 750 mm at the highest elevations and 250 mm in some basins. In the north minimum precipitation is in spring, and in the south it is early in summer. Winter precipitation is snow. *Average annual temperature*—6 to 7°C. *Average freeze-free period*—Generally 90 to 125 days, but it is only 80 days at the highest elevations.

Water: Precipitation is too low for good growth of crops in some parts of the area, but in others it is adequate for grain farming and forage production. The major rivers provide most of the water for irrigation, but small streams furnish local supplies. Ground water is abundant in the fill in some valleys, but in most of the area ground water is meager or is lacking.

Soils: Soils of this area are mostly Borolls, Orthents, and Fluvents. They are medium textured to fine textured and mainly well drained and have a frigid temperature regime. Moderately deep to deep Argiborolls (Absarokee, Farnuf, and Savage series), Haploborolls (Winifred and Rottulee series), and Natriborolls (Adger series) are on sedimentary uplands, alluvial fans, foot slopes, and terraces. Shallow Argiborolls (Sinnigam and Amherst series), Haploborolls (Castner series), and Ustorthents (Cabba and Wayden series) are on sedimentary uplands. Deep, nearly level to gently sloping Ustifluvents (Havrelon and Lohler series) are on flood plains and low alluvial

terraces. Soils in wooded areas are at higher elevations where more rainfall is received.

Potential natural vegetation: This area supports grass vegetation in the valleys and foothills and forest vegetation at higher elevations. Bluebunch wheatgrass, rough fescue, Idaho fescue, and western wheatgrass are the major grass species. Ponderosa pine, Rocky Mountain juniper, common snowberry, and skunkbush sumac are dominant species in forests.

47—Wasatch and Uinta Mountains

Colorado, Idaho, Utah, and Wyoming
53,150 km² (20,520 mi²)

Land use: Less than one-third of this area is in farms and ranches. Most of the remainder is federally owned. There are several national parks and monuments and primitive areas. Some land is set aside as Indian reservations. Grassland and woodland are grazed in summer. Some dense forests are on moist sites. Recreation and mining are important land uses. A few valleys are irrigated; forage for livestock is the main crop, but a few other crops are grown.

Elevation and topography: Elevation generally ranges from 1,500 to 2,700 m, but on some peaks it is 4,100 m. These strongly sloping to precipitous mountains have narrow crests and valleys. Some high plateaus have gently sloping tops and steep sides. The mountains are dissected by many streams, and lakes are common on mountain crests that have been glaciated.

Climate: *Average annual precipitation*—Mainly 375 to 750 mm but as much as 1,025 mm on some mountain peaks. Precipitation is evenly distributed throughout the year. Much of the precipitation is snow. *Average annual temperature*—2 to 8°C, decreasing with elevation. *Average freeze-free period*—Mainly 60 to 120 days, but there is no frost-free period on some high mountain peaks.

Water: Streams, lakes, and ground water supply enough water for the range and forestry enterprises in most of the area. Perennial streams provide irrigation water in the few major valleys.

Soils: Orthents, Fluvents, Aquolls, and Xerolls are common in the valleys. Ochrepts, Xerolls, Borolls, Boralfs, and Xeralfs are on mountain slopes. These soils have a frigid or cryic soil temperature regime and mixed, montmorillonitic, or carbonatic mineralogy. They formed in mixed parent materials of sedimentary and igneous rocks. Deep wet soils in the valley are Haplaquolls (Crooked Creek, Canburn, and Kovich series). Well drained Ustifluvents (Neto, Shupert, and Winetti series), Ustorthents (Podo and Ruko series), Xerorthents (Redcan series), and Calcixerolls (Calita and Lundy series) are in valleys. Palexerolls (Borvant series) are on old alluvial fans and low mountain foot slopes; they have a lime-cemented hardpan. On mountain slopes are shallow

to deep Haploxerolls (Agassiz, Bradshaw, and Foxol series), Haploborolls (Brycan and Datino series), Argixerolls (Henefer, Smarts, and Wallsburg series), Argiborolls (Barfuss and LaPlatta series), and Palexerolls (Harkers, Goring, and Norcan series). In the high mountain areas are deep Paleborolls (Lucky Star, Elzinga, and Flygare series), Paleboralfs (Fitzgerald series), Cryoborolls (Bickmore, Daybell, and Dateman series), Cryoboralfs (Cliff, Duchesne, and Condie series), Cryochrepts (Scout, Lake Janee, and Marsell series), and Cryorthents (Mirrow Lake series).

Potential natural vegetation: This area supports conifer, aspen, grasses, mountain shrub, and sagebrush-grass vegetation. Big sagebrush and bluebunch wheatgrass are dominant sagebrush-grass species. The zone above an elevation of about 4,000 m supports alpine meadow. The conifers are Engelmann spruce, white fir, subalpine fir, Douglas-fir, lodgepole pine, and ponderosa pine. Numerous grasses and forbs grow under the aspen. Bluebunch wheatgrass, bearded wheatgrass, blue wildrye, mountain brome, several bluegrasses, and numerous forbs grow as an understory with Gambel oak, curlleaf and birchleaf mountainmahogany, snowberry, serviceberry, and chokecherry.

48A—Southern Rocky Mountains

Colorado, New Mexico, Utah, and Wyoming
112,050 km² (43,260 mi²)

Land use: More than one-half of this area is federally owned. The remainder consists of farms, ranches, or other private holdings. The upper mountain slopes, below timberline, are forested. Grassland occurs above timberline at lower elevations and in valleys. Most of the grassland and much of the open woodland is grazed. Recreation, mining, and wildlife habitat are important land uses throughout this area. Small valleys are irrigated and used for growing hay and pasture for livestock.

Elevation and topography: Elevation ranges from 2,300 to 4,300 m. These strongly sloping to precipitous mountains are dissected by many narrow stream valleys having steep gradients. In places the upper mountain slopes and crests are covered by snowfields and glaciers. High plateaus and steep-walled canyons are fairly common, especially in the west.

Climate: *Average annual precipitation*—Generally 375 to 750 mm but as much as 1,025 mm or more on some of the higher mountains. Most of the precipitation falls in winter as snow. *Average annual temperature*—0 to 7° C. *Average freeze-free period*—Generally less than 70 days.

Water: Water from the streams and lakes is abundant, and ground water is plentiful. The lower valleys depend on streamflow from this area for irrigation water.

Soils: Most of the soils are Boralfs. They are moderately deep, stony and very stony, and medium textured. They have an ustic or udic moisture regime, a cryic temperature regime, and mixed mineralogy. Cryoboralfs (Peeler and Frisco series) are on timbered mountain slopes. Shallow Cryorthents (Crespin and Mine series) are on very steep grass- and shrub-covered breaks. Deep and moderately deep Cryoborolls (Woodhall and Carbol series) are on lower fans and valleys. Cryochrepts and Cryaquepts (Bottle and Vasquez series) and areas of rock outcrop are above timberline.

Potential natural vegetation: This area supports forests on upper slopes, alpine tundra above timberline, and shrub-grass vegetation at lower elevations. Grasses, sagebrush, and other shrubs grow on the lower slopes and in valleys. Lodgepole pine, aspen, Douglas-fir, and ponderosa pine are major trees of the lower forest. Engelmann spruce, subalpine fir, white fir, and limber pine intermingled with stands of aspen are typical on the mountain slopes. Willow, alder, and birch trees grow along streams. The timberline zone is characterized by stunted and wind-twisted limber pine, bristlecone pine, Engelmann spruce, and subalpine fir. Alpine grasses, herbaceous plants, and shrubs constitute the treeless alpine tundra.

48B—Southern Rocky Mountain Parks

Colorado
20,110 km² (7,770 mi²)

Land use: About one-half of this area is federal land leased to ranchers for grazing of cattle and sheep. The remainder is privately owned ranches. Irrigated pastures and hayland adjacent to most of the rivers and streams provide most of the forage. Hay consists mainly of grasses and sedges and a small amount of clover. Grazing land is sparsely vegetated with grasses and shrubs and is low in production because of inadequate rainfall and low temperatures.

Elevation and topography: Elevation ranges from 2,400 to 3,300 m. This area consists of nearly level to rolling mountain parks and valleys and a few narrow mountain ridges.

Climate: *Average annual precipitation*—175 to 300 mm. About one-half of the precipitation falls as snow. Moisture is unevenly distributed within short distances because of snowdrifts. *Average annual temperature*—1 to 7°C. *Average freeze-free period*—Generally less than 70 days.

Water: Perennial streams originating from snowmelt in the adjacent high mountains furnish an abundance of water for irrigation of hay meadows in June and July. In August the streams are often short of water. Large reservoirs store water for domestic, power, and irrigation uses outside the area.

Soils: Most of the soils are Borolls. They are deep and moderately deep, very cobbly, and medium textured to coarse textured. They have an aridic or ustic moisture regime, a cryic temperature, and mixed mineralogy. Cryoborolls (Eyre and Bucklon series) formed in outwash and alluvium on the broad, grass-covered valley floors and slopes. Haplargids and Cryorthents on steeper slopes are primarily in residuum from sedimentary rocks.

Potential natural vegetation: This area supports grass and grass-shrub vegetation. Big sagebrush, rabbitbrush, and winterfat are dominant shrubs. Arizona fescue, mountain muhly, sod-forming wheat-grasses, needlegrass, and bluegrasses are dominant grasses.

49—Southern Rocky Mountain Foothills

Colorado and Wyoming
32,680 km² (12,620 mi²)

Land use: At least four-fifths of this area is in farms and ranches. Nearly all the remainder is federally owned. The grassland and woodland are grazed. Hay, pasture, and feed grains are grown in irrigated valleys, which make up less than 5 percent of the total area. A small acreage is dry-farmed to wheat.

Elevation and topography: Elevation ranges from 1,700 to 2,400 m. These rugged hills and low mountains are in narrow bands along the eastern slopes of the Rocky Mountains. They are strongly dissected and in many places are crossed by large streams flowing eastward from the Rocky Mountains. In most places, local relief is about 100 m.

Climate: *Average annual precipitation*—125 to 500 mm. Precipitation is low in winter, increases from spring to midsummer, and decreases in autumn. *Average annual temperature*—4 to 10°C. *Average freeze-free period*—Generally 120 to 160 days, but it is shorter at higher elevations, especially in the north.

Water: The major streams crossing the area provide irrigation water for narrow belts of cropland in their valleys, but elsewhere water is scarce.

Soils: Most of the soils are Ustolls, Borolls, and Boralfs. They are mostly deep and have an ustic moisture regime, a mesic or frigid temperature regime, and mixed mineralogy. Deep loamy Argiustolls (Bresser series), Argiborolls (Peyton series), and Eutroboralfs are dominant. They formed mainly in locally transported sediments on the more smoothly sloping sites. Shallow Haplustolls and Torriorthents are on steep and broken hill slopes.

Potential natural vegetation: This area supports vegetation transitional between that of the grasslands of the plains and the forests of the mountains. A broad belt of short grasses and shrubs (oak, mountainmahogany, antelope bitterbrush, and others) intermingles with open stands of ponderosa pine, Douglas-fir, pinyon, and juniper on the hillsides and

blue spruce, alder, narrowleaf cottonwood, birch, and willow along the streams. Gramas, needlegrasses, bluegrasses, and sod-forming wheatgrasses are the major grasses.

51—High Intermountain Valleys

Colorado and New Mexico
10,060 km² (3,880 mi²)

Land use: Nearly one-half of this area is federally owned. The remainder is in farms and ranches. The Great Sand Dune National Monument is in this area. Desert shrubs and short grasses cover most of the land. About 25 percent of the area is irrigated cropland. Major crops are potatoes, malt barleys and other small grains, field peas, cool-season vegetables, and hay. The native range is grazed in summer, but it has a low carrying capacity.

Elevation and topography: Elevation ranges from 2,100 to 2,700 m. Much of the area consists of nearly level to gently sloping old valley fill. Gently sloping to steep hills underlain by basalt are extensive in the south. Local relief is slight except in the south, where it is as much as 100 m.

Climate: *Average annual precipitation*—150 to 500 mm, increasing from north to south. Most of the precipitation falls during the growing season. *Average annual temperature*—4 to 10°C. *Average freeze-free period*—100 to 140 days.

Water: The low precipitation in the north supports only a sparse cover of range plants, but rainfall in the south is adequate for a good cover of grass and sagebrush. Irrigation water is provided by the Rio Grande River and small reservoirs on intermittent streams flowing into the area from surrounding mountains. The Chama River is an important water source in the south. Wells that tap ground water in the deep valley fill are also an important source of water for irrigation and domestic use. Salinity is a problem in much of the area.

Soils: Most of the soils are Argids. They are deep and moderately deep and coarse textured to medium textured. They have an aridic moisture regime, a frigid temperature regime, and mixed mineralogy. Deep loamy Haplargids (Graypoint and Asacio series) are commonly underlain by sand or gravel formed in alluvium on valley floors and gentle slopes. Natrargids are extensive in the broader valleys. Mostly shallow Haploborolls and Torriorthents are on steeper slopes.

Potential natural vegetation: This area supports desert shrub-grassland vegetation. Greasewood, rabbitbrush, fourwing saltbush, saltgrass, alkali sacaton, wheatgrasses, sedges, and rushes are common at the lower elevations. Pinyon and juniper, Indian ricegrass, blue grama, needleandthread, wheatgrasses, and bluegrasses grow at higher elevations. Narrowleaf cottonwood grows along the major streams.

F—NORTHERN GREAT PLAINS SPRING WHEAT REGION

351,990 km² (135,900 mi²)

The fertile soils and the dominantly smooth topography of this region are favorable for agriculture, but the low precipitation and a short growing season severely limit the crops that can be grown. The average annual precipitation ranges from 250 to 550 mm. A large part of the precipitation falls during the growing season. The average annual temperature is 4 to 9°C in most of this region. The freeze-free period ranges from 100 to 155 days, increasing from north to south.

Borolls and Aquolls are dominant soils. Borolls are on uplands, and Aquolls are in low wet areas and along streams. Aquolls are extensive in the Red River Valley in the eastern part of the region. Some of the Borolls have a high content of sodium, and some of the Aquolls have a high content of sodium and lime. Other important soils are Orthents on steep slopes and Ustolls in the southern part of the region.

Spring wheat grown by dryfarming methods is the major crop. Other spring grains, flax, and hay are also grown. Potatoes, sugarbeets, soybeans, and corn are important crops in the Red River Valley.

52—Brown Glaciated Plain

Montana

52,110 km² (20,120 mi²)

Land use: Nearly all this area is in farms and ranches.

Level tracts, mostly in the west and making up almost one-half of the total area, are cropped. Spring wheat is the major cash crop, but feed grains and hay are also grown on most farms. Most of the land in the east is in range, but gently sloping soils are dry-farmed to wheat. Narrow discontinuous strips along the Milk River are irrigated. Feed grains, corn silage, hay, and tame pasture are grown on much of the irrigated land, and sugarbeets are an important cash crop.

Elevation and topography: Elevation generally ranges from 600 to 1,400 m, increasing from east to west, but it is as much as 2,100 m in the Sweetgrass Hills. This glaciated plain is nearly level to gently rolling, but belts of steep slopes border some of the larger rivers. The Milk River has extensive flood plains, but flood plains along the other streams are narrow and discontinuous.

Climate: *Average annual precipitation*—250 to 375 mm in most of the area and as much as 500 mm in the Sweetgrass Hills. Maximum precipitation is from spring through early summer. Precipitation in winter is snow. *Average annual temperature*—3 to 7°C. *Average freeze-free period*—100 to 130 days.

Water: Most of the area depends on precipitation for water for both range and crops. The Milk River provides irrigation water to its flood plains and immediate adjacent land. On the uplands, water for livestock is stored in small reservoirs. The glacial drift yields a moderate amount of ground water that is hard but otherwise of good quality.

Soils: Most of the soils are Borolls, Orthents, Argids, and Fluvents. These soils are medium textured to fine textured and well drained and have a frigid

temperature regime. Deep, nearly level to strongly rolling Argiborolls (Scobey and Telstad series) are on glacial till plains. Shallow to deep, nearly level to steep Torriorthents (Lisam, Hillon, and Marias series) are on shaly uplands, glacial till plains, and lacustrine terraces, fans, and foot slopes. Deep, nearly level to moderately sloping Natrargids (Absher and Thoeny series) are on alluvial fans and low terraces adjacent to drainageways and on glacial till plains. Deep, nearly level and undulating Paleargids (Phillips series) are on glacial till plains. Deep, nearly level Torrifluvents (Harlem and Havre series) are on flood plains and low terraces. Included with these soils are some soils in the Sweetgrass Hills. Wet or saline soils along streams or in seep spots are also included.

Potential natural vegetation: This area supports grassland vegetation. Bluebunch wheatgrass, needleand-thread, western wheatgrass, green needlegrass, and basin wildrye are dominant species.

53A—Northern Dark Brown Glaciated Plains

Montana and North Dakota

30,740 km² (11,870 mi²)

Land use: Most of this area is in farms and ranches. Slightly more than one-half is cropland that is dry-farmed. Spring wheat is the chief crop, but flax, oats, and barley are grown on some farms. The more sloping soils are in range of native grasses.

Elevation and topography: Elevation ranges from 600 to 900 m, increasing gradually from southeast to northwest. These gently undulating to rolling till plains include areas of kettle holes, kames, and moraines. Strongly rolling and steep slopes are adjacent to major stream valleys.

Climate: *Average annual precipitation*—300 to 350 mm. More than half of the precipitation falls during

the growing season. Winter precipitation is snow. *Average annual temperature*—3 to 5°C. *Average freeze-free period*—110 to 125 days.

Water: In most years, moisture is inadequate for maximum crop production. The Missouri River is the only dependable source of water for irrigation; therefore, only a small acreage is irrigated. There is a limited supply of ground water. In places, dug ponds are a source of water for livestock.

Soils: Most of the soils are Borolls. They are deep, well drained, and medium textured and have a frigid temperature regime and mixed mineralogy. The nearly level and undulating Argiborolls (Williams and Bowbells series) are on till plains. The steeper Haploborolls (Zahl and Max series) are on uplands; others (Arnegard series) are on small fans and terraces. Very poorly drained Argiaquolls (Parnell series) and poorly drained Argialbolls (Tonka series) are in kettle holes.

Potential natural vegetation: This area supports natural prairie vegetation characterized by western wheatgrass, needleandthread, green needlegrass, and blue grama. Little bluestem is an important species on sloping and thin soils. Prairie cordgrass, northern reedgrass, and slim sedge are important species on wet soils. Western snowberry, stiff goldenrod, echinacea, and prairie rose are commonly interspersed throughout the area.

53B—Central Dark Brown Glaciated Plains

North Dakota and South Dakota
44,980 km² (17,370 mi²)

Land use: Most of this area is in farms and ranches, and about two-thirds is cropland that is dry-farmed. Spring wheat is the chief crop, but flax, oats, barley, and alfalfa are grown on many farms. The more sloping soils are in range of native grasses.

Elevation and topography: Elevation ranges from 500 to 600 m, increasing gradually from southeast to northwest. These nearly level to rolling till plains include areas of kettle holes, kames, moraines, and small glacial lakes. Moderately steep and steep slopes are adjacent to major stream valleys.

Climate: *Average annual precipitation*—350 to 425 mm. More than half of the precipitation falls during the growing season. Winter precipitation is snow. *Average annual temperature*—1 to 7°C. *Average freeze-free period*—110 to 130 days.

Water: In most years moisture is inadequate for maximum crop production. The Missouri River is the only dependable source of water for irrigation; therefore, only a small acreage is irrigated. There is a limited supply of ground water. In places, ponds are a source of water for livestock.

Soils: Most of the soils are Borolls. They are deep, well drained, and medium textured and have a frigid temperature regime and mixed mineralogy. The nearly

level and undulating Argiborolls (Williams and Bowbells series) are on till plains. Haploborolls (Zahl and Max series) are on steeper uplands. The nearly level to gently sloping Natriborolls (Noonan and Niobell series) are scattered on till plains. Very poorly drained Argiaquolls (Parnell series) and poorly drained Argialbolls (Tonka series) are in kettle holes.

Potential natural vegetation: This area supports natural prairie vegetation characterized by western wheatgrass, needleandthread, green needlegrass, and blue grama. Little bluestem is an important species on sloping and thin soils. Prairie cordgrass, northern reedgrass, and slim sedge are important species on wet soils. Western snowberry, stiff goldenrod, echinacea, and prairie rose are commonly interspersed throughout the area.

53C—Southern Dark Brown Glaciated Plains

South Dakota
13,870 km² (5,350 mi²)

Land use: Most of this area is in farms and ranches, and slightly more than half is cropland that is dry-farmed. Winter wheat is the chief cash crop. Corn, grain, sorghum, oats, and alfalfa are grown on many farms. The more sloping soils are in range.

Elevation and topography: Elevation ranges from 400 to 700 m. These nearly level to gently rolling till plains include many areas of potholes. Moderately steep and steep slopes are adjacent to major valleys.

Climate: *Average annual precipitation*—425 to 475 mm. More than half of the precipitation falls during the growing season. Precipitation in winter is snow. *Average annual temperature*—7 to 9°C. *Average freeze-free period*—130 to 150 days.

Water: In most years, moisture is inadequate for maximum crop production. The Missouri River is the only dependable source of water for irrigation; therefore, irrigated cropland is mostly confined to a narrow band along its valley. There is a limited supply of ground water. Most water for livestock comes from dug ponds.

Soils: Most of the soils are Ustolls. They are deep, well drained, and medium textured and have a mesic temperature regime and mixed mineralogy. The nearly level to moderately sloping Argiustolls (Highmore, Eakin, and Glenham series) are on uplands, and other Argiustolls (Mobridge and Onita series) are in swales. Natrustolls (Cavo, Demky, and Jerauld series) also are on uplands. Ustorthents (Betts series) are on the steeper parts of the landscape, and Natraquolls (Hoven series) are in upland depressions.

Potential natural vegetation: This area supports natural prairie vegetation. Western wheatgrass, blue grama, needleandthread, and green needlegrass are dominant species. Little bluestem and prairie sandreed are important species on steeper sites. Western

snowberry and prairie rose are commonly interspersed throughout the area.

54—Rolling Soft Shale Plain

Montana, North Dakota, and South Dakota

58,100 km² (22,430 mi²)

Land use: Nearly all this area is in farms and ranches. In most places agriculture is a combination of livestock production and cash grain farming. About three-fifths of the area is in native grasses and shrubs that are grazed. The less sloping soils, making up about one-third of the total area, are dry-farmed. Wheat, other small grains, feed grains, hay, silage corn, and flax are the principal crops. Small tracts on the bottom land along the Missouri River and a few of its larger tributaries are irrigated.

Elevation and topography: Elevation is 500 m in the east and gradually slopes to about 1,100 m in the west. This moderately dissected rolling plain is underlain by soft calcareous shale, siltstone, and sandstone. Maximum local relief is about 100 m but is considerably less in most of the area. Buttes, badland, and moderately steep and steep slopes are adjacent to major valleys. The northern and eastern parts have a glacially modified topography and in some places are covered by thin layers of glacial drift.

Climate: *Average annual precipitation*—325 to 450 mm. Most of the precipitation falls during the growing season. Precipitation in winter is snow. *Average annual temperature*—4 to 7°C. *Average freeze-free period*—110 to 135 days.

Water: In most years the supply of moisture is inadequate for maximum crop production. Water for irrigation is available in quantity only from the Missouri River and a few of its larger tributaries. Water for livestock is stored in small reservoirs on uplands. A small area of sand and gravel yields moderate quantities of ground water. Ground water is scarce or is lacking in areas underlain by shale.

Soils: Most of the soils are Borolls. They are moderately deep and deep, well drained and moderately well drained, and loamy and clayey. These soils have a frigid temperature regime and mixed mineralogy. The nearly level to rolling Haploborolls (Vebar and Chama series) and Argiborolls (Morton series) are on sedimentary uplands. The more sloping, shallow Ustorthents (Cabba series) and Ustipsamments (Flasher series) are on sedimentary uplands. The nearly level and gently sloping Natriborolls (Rhoades and Belfield series) are on sedimentary uplands and alluvial fans and terraces. The nearly level to gently sloping Argiborolls (Williams and Vida series) are on till-mantled sedimentary uplands in the northern and eastern parts of the area. Ustochrepts (Cherry series) and Ustorthents (Lambert series) are on fans, terraces, and foot slopes.

Potential natural vegetation: This area supports natural prairie vegetation. Western wheatgrass, blue grama, needleandthread, and green needlegrass are dominant species. Prairie sandreed and little bluestem are important species on the very shallow soils. Buffaloberry, chokecherry, and prairie rose are common in draws and narrow valleys.

55A—Northern Black Glaciated Plains

North Dakota

32,240 km² (12,450 mi²)

Land use: Nearly all this area is in farms and ranches, and about 80 percent is cropland that is dry-farmed. Cash-grain wheat production is the principal enterprise on many farms, but other cash grains, feed grains, hay, flax, and sunflowers also are grown. The more sloping and thinner or sandy soils are in native range. About 3 percent of this area is forested.

Elevation and topography: Elevation ranges from 300 to 700 m, increasing from east to west. These mostly nearly level to undulating till plains include areas of kettle holes, kames, and moraines. Also in the area are glacial lake plains and some steep slopes adjacent to streams.

Climate: *Average annual precipitation*—375 to 450 mm. More than half of the precipitation falls during the growing season. Precipitation in winter is snow. *Average annual temperature*—3 to 4°C. *Average freeze-free period*—100 to 120 days.

Water: In most years precipitation is inadequate for maximum crop production. The few perennial streams are widely spaced and are little used for irrigation. Water for livestock is stored in ponds and small reservoirs on individual farms and ranches. Ground water is plentiful in glacial drift, but the water is hard. Sandstone underlying part of the area yields large quantities of highly mineralized artesian water, but the shale yields very little water.

Soils: Most of the soils are Borolls and Aquolls. They are deep, well drained to poorly drained, and sandy, loamy, and clayey and have a frigid temperature regime and mixed mineralogy. The nearly level and undulating Haploborolls (Barnes, Svea, Gardena, and Hecla series) are on till plains and glacial lake plains. Very poorly drained Argiaquolls (Parnell series) and Argialbolls (Tonka series) are in kettle holes. The sloping to steep Haploborolls (Buse series) are on till plains. Argiborolls (Bottineau and Kelvin series) are on till plains in the forested areas.

Potential natural vegetation: This area supports natural prairie vegetation characterized by western wheatgrass, needleandthread, green needlegrass, and blue grama. Little bluestem is an important species on sloping and thin soils. Prairie cordgrass, northern reedgrass, big bluestem, and slim sedge are important species on wet soils. Western snowberry and prairie rose are commonly interspersed throughout

the area. A small part of the area can support forest vegetation characterized by oak and aspen.

55B—Central Black Glaciated Plains

North Dakota and South Dakota

52,480 km² (20,260 mi²)

Land use: Nearly all this area is in farms and ranches, and about 70 percent is cropland that is dry-farmed. Cash-grain wheat production is the principal enterprise on many farms. Other small grains, feed grains, hay, flax, and sunflowers are also grown. About one-fourth of the area, consisting of the more sloping and thinner soils, is native range and some woodland.

Elevation and topography: Elevation ranges from 300 to 600 m, increasing from east to west. Most of this area is nearly level to undulating till plains that include areas of kettle holes, kames, and moraines. Glacial lake plains and some steep slopes are adjacent to streams.

Climate: *Average annual precipitation*—400 to 500 mm. More than half of the precipitation falls during the growing season. Precipitation in winter is snow. *Average annual temperature*—4 to 7°C. *Average freeze-free period*—120 to 140 days.

Water: In most years precipitation is inadequate for maximum crop production. Perennial streams are few and widely spaced and are little used for irrigation. Water for livestock is stored in ponds and small reservoirs on individual farms and ranches. Ground water is plentiful in glacial drift, but the water is hard. Sandstone underlying part of the area yields large quantities of highly mineralized artesian water, but the shale yields very little water.

Soils: Most of the soils are Borolls. They are deep, well drained and moderately well drained, and sandy to clayey and have a frigid temperature regime and mixed mineralogy. The nearly level and undulating Haploborolls (Barnes, Svea, Emrick, Heimdal, and Aastad series) and Argiborolls (Forman series) are on till plains. The nearly level Haploborolls (Gardena and Hecla series) and Natriborolls (Aberdeen series) are on glacial lake plains. The sloping to steep Haploborolls (Buse series) are on till plains. Very poorly drained Argiaquolls (Parnell series) are in kettle holes.

Potential natural vegetation: This area supports natural prairie vegetation characterized by western wheatgrass, needleandthread, green needlegrass, and blue grama. Little bluestem is an important species on sloping and thin soils. Prairie cordgrass, northern reedgrass, big bluestem, and slim sedge are important species on wet soils. Western snowberry and prairie rose are commonly interspersed throughout the area.

55C—Southern Black Glaciated Plains

South Dakota

20,240 km² (7,810 mi²)

Land use: Nearly all this area is in farms and ranches, and about 70 percent is cropland that is dry-farmed. Corn, small grains, and alfalfa are the principal crops. Grain sorghum is also grown. About one-fourth of the area, consisting of the steeper sloping soils, is in native range and tame pasture.

Elevation and topography: Elevation ranges from 400 to 600 m. Most of the area is nearly level to undulating till plains with potholes and moraines. Steep slopes are adjacent to the major streams.

Climate: *Average annual precipitation*—450 to 525 mm. More than half of the precipitation falls during the growing season. Precipitation in winter is snow. *Average annual temperature*—7 to 9°C. *Average freeze-free period*—130 to 155 days.

Water: In most years precipitation is inadequate for maximum crop production. Perennial streams are few and widely spaced and are little used for irrigation. Water for livestock is stored in ponds and small reservoirs on individual farms and ranches. Sandstone underlying part of the area yields large quantities of highly mineralized artesian water, but the shale yields very little water. Water from reservoirs on the Missouri River is used for irrigation on the adjacent upland soils.

Soils: Most of the soils are Ustolls. They are deep, well drained and moderately well drained, and sandy to clayey. These soils have a mesic temperature regime and mixed mineralogy. The nearly level to moderately sloping Argiustolls (Houdek and Prosper series), Haplustolls (Clarno, Ethan, and Bonilla series), and Natrustolls (Dudley, Jerauld, and Stickney series) are on till plains. Ustorthents (Betts series) occupy the steeper parts of the landscape, and Argialbolls (Tetonka series) are in upland depressions.

Potential natural vegetation: This area supports natural prairie vegetation characterized by western wheatgrass, green needlegrass, needleandthread, and porcupinegrass. Big bluestem is an important species on soils with restricted drainage. Prairie cordgrass, northern reedgrass, and western wheatgrass are dominant on the poorly drained and very poorly drained soils.

56—Red River Valley of the North

Minnesota, North Dakota, and South Dakota

41,230 km² (15,920 mi²)

Land use: Nearly all this area is in farms and ranches, and about 80 percent is cropland that is dry-farmed. Important cash crops are spring wheat, soybeans, potatoes, sugar beets, and corn. Some oil-producing crops and edible beans are grown. On some farms,

feed grains and forage for dairy cattle are the principal crops. Nearly 10 percent of the area in the northeast is wooded.

Elevation and topography: Elevation is 300 m, decreasing gradually to 200 m in the north. This nearly level glacial lake plain is bordered on the east by outwash, gravelly beaches, and dunes.

Climate: *Average annual precipitation*—475 to 550 mm. More than half of the precipitation falls during the growing season. Precipitation in winter is snow. *Average annual temperature*—2 to 7°C, decreasing from south to north. *Average freeze-free period*—105 to 135 days.

Water: Efficient use of water is a major concern of management. In years of normal precipitation, moisture is sufficient for commonly grown crops. In some places drainage systems are needed so that farming

operations can be started when the temperature is favorable.

Soils: Most of the soils are Aquolls. They are deep, somewhat poorly drained and poorly drained, and sandy to clayey and have a frigid temperature regime. Calciaquolls (Bearden, Hegne, Glyndon, and Ulen series), Haplaquolls (Fargo series), and Haploborolls (Gardena and Embden series) are on the glaciolacustrine plains.

Potential natural vegetation: This area supports natural prairie vegetation characterized by little bluestem, big bluestem, switchgrass, and indiangrass. Bur oak, American basswood, American elm, eastern cottonwood, green ash, and willows grow in drainageways. Shrubs include American plum, common chokecherry, skunkbush sumac, and western snowberry.

G—WESTERN GREAT PLAINS RANGE AND IRRIGATED REGION

564,490 km² (217,950 mi²)

This section of the Great Plains is rolling upland. The soils are underlain by clay shale, siltstone, soft sandstone, and (locally) thick alluvium. The average annual precipitation ranges from 275 to 600 mm but fluctuates widely from year to year. The average annual temperature ranges from 7°C in the north to 16°C in the south. The freeze-free period ranges from 100 days in the north to 200 days in the south.

Ustolls are dominant throughout much of the region, but Argids are common in the west and in the south. Orthents on dissected slopes, Psamments in sandy areas, and Fluvents on flood plains are also extensive. Usterts in heavy clays are important locally.

The major part of this region is in range. Some wheat is dry-farmed, mainly along the eastern margin. Irrigation, particularly sprinkler, is increasingly practiced. Feed grain for livestock is the principal crop grown on the irrigated land. Potatoes, sugar beets, corn, and vegetables are important locally.

58A—Northern Rolling High Plains, Northern Part

Montana and Wyoming
105,620 km² (40,780 mi²)

Land use: Most of this area consists of privately owned ranches. The remainder is federally owned. Most of it is in native grasses and shrubs grazed by cattle and sheep. The rest is mainly dry-farmed to wheat. Narrow strips of land along the Yellowstone River and its main tributaries are irrigated. Sugar beets, alfalfa, other hay crops, and corn for silage are the principal crops. Some of the land is in tame pasture. The upper slopes and tops of some of the higher buttes and mountains are open woodland.

Elevation and topography: Elevation generally ranges from 900 to 1,800 m, increasing from east to west and from north to south, but in a few mountains it is as high as 2,100 m. These dissected plains are underlain by shale, siltstone, and sandstone. Slopes are mostly gently rolling to steep, and wide belts of steeply sloping badland border a few of the larger river valleys. Local relief is mainly in meters to tens of meters. In places, flat-topped, steep-sided buttes rise sharply above the general level of the plains.

Climate: *Average annual precipitation*—300 to 500 mm in most of the area and as much as 750 mm in the mountains, but it fluctuates widely from year to year. Maximum precipitation is in spring and early in autumn. Precipitation in winter is snow. *Average annual temperature*—4 to 7°C. *Average freeze-free period*—120 to 140 days.

Water: The low and erratic precipitation is the principal source of water for agriculture. Water for livestock is stored in small reservoirs, but supplies are inadequate for significant irrigation. Irrigation water in quantity is available only along the Yellowstone River and one or two of its larger tributaries. Ground water is scarce in most of the area, but locally sand and gravel deposits and coal beds yield small to moderate amounts.

Soils: Most of the soils are Orthents, Orthids, Argids, Borolls, and Fluvents. They are medium textured to fine textured, shallow to deep, and mainly well drained. Most of these soils have a frigid temperature regime, but soils in some wide river valleys, such as the Yellowstone River Valley, have a mesic temperature regime. The nearly level to steep Torriorthents (Lisam, Cabbart, and Lambeth series), Camborthids (Yamac, Lonna, and Cambeth series), Calciorthids (Crago and Cargill series), Haplargids (Bonfri series), Natrargids (Absher series), and Argiborolls (Tanna, Ethridge, and Evanston series) are on sedimentary uplands, fans, terraces, and foot slopes. The nearly level Torrifluvents (Havre and Glendive series) are on flood plains and low stream terraces.

Potential natural vegetation: This area supports grassland vegetation. Western wheatgrass, bluebunch wheatgrass, green needlegrass, and needleandthread are dominant species. In the eastern part of the area, little bluestem replaces bluebunch wheatgrass as the dominant species.

58B—Northern Rolling High Plains, Southern Part

Montana and Wyoming
50,810 km² (19,620 mi²)

Land use: More than two-thirds of this area is in ranches. Most of the remainder is federally owned. Nearly 80 percent of the area is in native grasses and shrubs grazed by cattle and sheep. Gently sloping deep soils, making up about 4 or 5 percent of the area, are dry-farmed to wheat. Narrow strips of land along the Tongue, Powder, and Platte Rivers and some of their tributaries are irrigated. Alfalfa, other hay crops, and feed grains are the principal crops. Some tracts are in tame pasture. The upper slopes and tops of some of the higher buttes and mountains are open woodland.

Elevation and topography: Elevation generally ranges from 900 to 1,800 m, increasing gradually from north

to south, but in a few buttes it is as high as 2,100 m. These dissected plains are underlain by shale and sandstone. Slopes are mostly gently rolling to steep, and wide belts of steeply sloping badland border a few of the larger river valleys. Local relief is mainly in tens of meters. In places, flat-topped, steep-sided buttes rise sharply above the general level of the plain.

Climate: *Average annual precipitation*—300 to 475 mm in most of the area but it fluctuates widely from year to year. Maximum precipitation is in spring and early in autumn. Precipitation in winter is snow. *Average annual temperature*—7 to 9°C. *Average freeze-free period*—100 to 130 days.

Water: The low and erratic precipitation is the principal source of water for agriculture. Water for livestock is stored in small reservoirs, but supplies are inadequate for significant irrigation. Irrigation water in quantity is available only along the major rivers and some of their larger tributaries. Ground water is scarce in most of the area, but in places, sand and gravel deposits and coalbeds yield small to moderate amounts.

Soils: Most of the soils are Orthents, Orthids, Argids, and Fluvents. They are moderately coarse textured to fine textured and mainly well drained and have a mesic temperature regime. The nearly level to steep, shallow to deep Torriorthents (Kim, Thedalund, Samsil, Shingle, and Tassel series) and the nearly level to steep, moderately deep to very deep Haplargids (Cushman, Olney, Terry, and Vona series) are on sedimentary uplands. The nearly level to moderately sloping, moderately deep to very deep Camborthids (Zigweid and McRae series) and Paleargids (Bidman and Briggsdale series) are on alluvial fans, foot slopes, and terraces. The nearly level, deep Torrifluvents (Haverson, Glenberg, and Bankard series) are on flood plains and low stream terraces.

Potential natural vegetation: This area supports grassland vegetation. Rhizomatous wheatgrasses, green needlegrass, needleandthread, blue grama, and threadleaf sedge are dominant species on deep soils. Bluebunch wheatgrass and little bluestem are major species on shallow soils on hills and ridges. Basin wildrye, green needlegrass, rhizomatous wheatgrasses, and shrubs are dominant along bottom land and streams. Big sagebrush is the dominant shrub.

58C—Northern Rolling High Plains, Northeastern Part

North Dakota
8,400 km² (3,240 mi²)

Land use: Most of this area is in ranches, and more than 80 percent is rangeland. Cow-calf operations are the principal livestock enterprise.

Elevation and topography: Elevation ranges from 600 to 1,000 m. This area consists mainly of badland

and moderately steep to steep slopes along the Little Missouri River and its tributaries. The Killdeer Mountains are also in this area.

Climate: *Average annual precipitation*—350 to 400 mm. More than half the precipitation falls during the growing season. Precipitation in winter is snow. *Average annual temperature*—4 to 6°C. *Average freeze-free period*—110 to 120 days.

Water: In most years, the supply of moisture is inadequate for maximum crop production. The Little Missouri River is the principal source of surface water. Ground water is scarce or is lacking in areas underlain by shale. Water for livestock is stored in ponds.

Soils: Most of the soils are Orthents. They are shallow and well drained to excessively drained and have a frigid temperature regime and mixed mineralogy. The moderately steep to very steep Torriorthents (Cabbart series) and Torripsammets (Fleak and Zeona series) and areas of badland are on strongly dissected sedimentary uplands.

Potential natural vegetation: This area supports natural prairie vegetation characterized by western wheatgrass, blue grama, little bluestem, and prairie sandreed. Rocky Mountain juniper, green ash, and quaking aspen are important species on some north-facing slopes. Silver sagebrush is common on bottom lands.

58D—Northern Rolling High Plains, Eastern Part

North Dakota and South Dakota
10,000 km² (3,860 mi²)

Land use: More than four-fifths of this area is in ranches. Most of the remainder is state and federally owned. Most of the area is in native grasses and shrubs grazed by cattle and sheep. Gently sloping, deep and moderately deep soils, making up 10 to 15 percent of the area, are dry-farmed to wheat and alfalfa. Some tracts are in tame pasture. The upper slopes and tops of some of the higher buttes are open woodland.

Elevation and topography: Elevation ranges from 700 to 1,000 m, increasing gradually from east to west. These dissected plains are underlain by shale and sandstone. Slopes are mostly gently rolling to steep. Local relief is mainly between 25 and 100 m. In places flat-topped, steep-sided buttes rise sharply above the general level of the plain.

Climate: *Average annual precipitation*—325 to 375 mm in most of the area, but it fluctuates widely from year to year. Maximum precipitation is in spring and early in summer. Precipitation in winter is snow. *Average annual temperature*—4 to 7°C. *Average freeze-free period*—120 to 130 days.

Water: The low and erratic precipitation is the principal source of water for agriculture. Water for livestock is stored in small ponds or dugouts. Some wells provide water for livestock.

Soils: Most of the soils are Orthents, Orthids, Argids, and Borolls. They are medium textured to fine textured and mainly well drained and have a frigid temperature regime. Nearly level to steep, shallow Torriorthents (Blackhall and Cabbart series) and nearly level to steep, moderately deep Camborthids (Twilight series) are on uplands. Nearly level to moderately sloping, deep and moderately deep Natrargids (Absher, Archin, Bullock, and Parchin series) are on alluvial fans, terraces, and uplands. Nearly level to strongly rolling, moderately deep and deep Argiborolls (Assinniboine, Evanston, and Marmarth series) are on uplands. Nearly level to rolling Torripsammets (Tusler and Zeona series) are on uplands. Torrifluvents (Glendive, Hanly, and Havre series) are on flood plains and low stream terraces.

Potential natural vegetation: This area supports natural mixed prairie vegetation characterized by western wheatgrass, green needlegrass, blue grama, and buffalograss. Little bluestem and sideoats grama grow on shallow soils. The upper slopes and tops of some of the higher buttes are in open ponderosa pine woodland. Silver and big sagebrush grow on clayey soils in the west.

60A—Pierre Shale Plains and Badlands

Nebraska, South Dakota, and Wyoming

23,600 km² (9,110 mi²)

Land use: Practically all this area is in farms and ranches. Most of it is in native grasses and is used for grazing livestock. Some small nearly level to moderately sloping tracts are farmed to winter wheat or are used for producing feed crops for livestock. The Badlands National Monument is a large tourist attraction.

Elevation and topography: Elevation is generally 800 to 1,100 m on uplands but ranges to 1,300 m. These shale plains have long, smooth slopes and are mostly gently sloping to strongly sloping. Along drainages and streams, slopes are moderately steep to steep. The Badlands consist of eroded walls and escarpments, small grass-covered tableland and mesas, and basins in which there are scattered eroded buttes. Slopes range from nearly level to very steep. This area is cut by many drainages and gullies.

Climate: *Average annual precipitation*—300 to 400 mm. Most of the precipitation falls during the growing season. Precipitation in winter is mainly snow that usually is accompanied by high winds that cause much drifting. Average snowfall is about 60 to 90 cm. *Average annual temperature*—7 to 9°C. *Average freeze-free period*—130 to 150 days.

Water: Because of the limited precipitation, production of cultivated crops is marginal. Most of the soils are moist or wet early in spring and are deficient in moisture during much of the growing season. Water for livestock comes mainly from runoff that flows into

dams. Few places have shallow-water wells for domestic use.

Soils: Most of the soils are Orthids. They are moderately deep and deep and fine textured and have a mesic temperature regime and montmorillonitic mineralogy. Nearly level to moderately sloping Camborthids (Kyle, Pierre, Swanboy, and Winler series) are on shale uplands. Shallow Torriorthents (Ennings, Lismas, Midway, and Samsil series) are on steeper slopes. Nearly level to gently undulating, deep and moderately deep, medium textured Argiustolls (Manter, Nunn, Satantz, Tuthill, Keith, and Richfield series) are on terraces and uplands. Shallow Torriorthents (Epping, Imlay, and Orella series) and Camborthids (Bufton and Conata series) are in the Badlands. Torrifluvents (Glenberg, Haverson, and Lohmiller series) are on the bottom land of major streams.

Potential natural vegetation: This area supports natural mixed prairie vegetation characterized by western wheatgrass, green needlegrass, blue grama, and buffalograss. Little bluestem and sideoats grama grow on the shallow soils. Big bluestem grows along streams, especially where an effective water table is present. Sand sagebrush grows on sandy soils and silver sagebrush on clayey soils in the west. The eroded walls and escarpments of the Badlands are devoid of vegetation.

60B—Pierre Shale Plains, Northern Part

Montana

5,600 km² (2,160 mi²)

Land use: Practically all this area is in farms and ranches. Most of it is rangeland used for grazing livestock. Some small nearly level to moderately sloping tracts are farmed to winter wheat or are used for growing feed crops for livestock.

Elevation and topography: Elevation ranges from 900 to 1,000 m on uplands. These shale plains have long, smooth, gentle to strong slopes. Slopes along drainageways and streams are moderately steep to steep.

Climate: *Average annual precipitation*—300 to 350 mm. Most of the precipitation falls during the growing season. Precipitation in winter is mainly snow, which usually is accompanied by high winds that cause much drifting. *Average annual temperature*—6 to 7°C. *Average freeze-free period*—110 to 125 days.

Water: Because of the limited precipitation, the growing of cultivated crops is marginal. Most of the soils are moist or wet early in spring and are deficient in moisture during much of the growing season. Water for livestock comes mainly from runoff that flows into dams.

Soils: The dominant soils are Orthids and Orthents. They are moderately deep and deep and fine textured

and have a frigid temperature regime and montmorillonitic mineralogy. Nearly level to moderately sloping Camborthids (Abor, Bascovy, and Bickerdyke series) are on shaly uplands. Shallow Torriorthents (Dilts, Lisam, and Yawdim series) are on steeper slopes. Torrifluvents (Harlem series) are on the bottom land of major streams.

Potential natural vegetation: This area supports natural mixed prairie vegetation characterized by western wheatgrass, green needlegrass, and blue grama. Little bluestem and sideoats grama grow on shallow soils.

61—Black Hills Foot Slopes

South Dakota and Wyoming

8,400 km² (3,240 mi²)

Land use: Most of this area is in farms and ranches. Native grass is used mainly for livestock grazing. Some of the less sloping parts are farmed mainly to alfalfa and small grains for livestock feed. Ponderosa pine grows in some parts marginal to the Black Hills.

Elevation and topography: Elevation is mainly 900 to 1,200 m but ranges to 1,700 m. Slopes are mostly hilly to steep. Drainages are well defined.

Climate: *Average annual precipitation*—375 to 450 mm. Most of the precipitation falls during the growing season. *Average snowfall in winter* is 60 to 100 cm. *Average annual temperature*—6 to 9°C. *Average frost-free period*—110 to 140 days.

Water: Crop production is marginal because of the limited precipitation. Most of the soils suitable for cultivation are dry during much of the growing season. Domestic water is provided mostly by flowing streams, shallow wells, and springs.

Soils: Most of the soils are Orthents. They are deep to shallow and fine textured to medium textured and have a mesic temperature regime. The medium textured soils have mixed mineralogy, and the fine textured soils have montmorillonitic mineralogy. Loamy Torriorthents (Butche, Canyon, Enning, Nevee, and Spearfish series) are on the steeper landscapes and clayey Torriorthents (Grummit series) on the smoother landscapes. Eutroboralfs (Lakoa and Maitland series) are on the edge of the Black Hills. The nearly level to moderately sloping, deep Haplustolls (Tilford series) and Argiustolls (Vale series) are in areas in the “redbed valley.”

Potential natural vegetation: This area supports open grassland, forest, and savanna vegetation. The grassland is characterized by little and big bluestem, green needlegrass, western wheatgrass, and needle-and-thread. Ponderosa pine grows in scattered open forest stands. Bur oak grows throughout the area, and in places it grows in nearly pure stands. Quaking aspen and eastern hophornbeam are scattered throughout the forests. Scattered green ash and American

elm grow along with big bluestem along stream bottoms.

62—Black Hills

South Dakota and Wyoming

9,200 km² (3,550 mi²)

Land use: Most of this area is in the Black Hills National Forest. The Black Hills area, an important tourist attraction, is used for mining, recreation, and hunting. Small farms and ranches, rural homes, and summer homes on small acreages are scattered throughout. Some timber is harvested. Small ranches and farms depend on the Black Hills National Forest for summer grazing.

Elevation and topography: Elevation is mainly 1,100 to 2,000 m, but it is 2,200 m on Harney Peak. Slopes range from moderate on some of the high plateaus to very steep along drainageways and on peaks and ridges. Narrow valleys are mostly gently sloping to strongly sloping.

Climate: *Average annual precipitation*—450 to 650 mm. Precipitation in winter is mostly snow that ranges from about 150 cm at lower elevations to as much as 360 cm at higher elevations. *Average annual temperature*—3 to 7°C. *Average freeze-free period*—80 to 130 days.

Water: Precipitation, perennial streams, springs, and shallow wells provide adequate water for domestic use. In most years soil moisture is adequate for normal plant growth.

Soils: Most of the soils are Boralfs. They have a frigid or cryic temperature regime and montmorillonitic mineralogy. Eutroboralfs (Citadel series), Haploborolls (Paunsaugunt series), and Eutrochrepts (Vannocker series) are at lower elevations, and Cryoboralfs are at higher elevations.

Potential natural vegetation: This area supports open to dense forest vegetation. Ponderosa pine is the dominant species. Black Hills spruce grows at higher elevations and along major drainageways. Paper birch and quaking aspen are on sites that have been burned over by wildfire. Kentucky bluegrass, poverty oatgrass, Richardson needlegrass, and Canada wildrye are common under open forest stands.

63A—Northern Rolling Pierre Shale Plains

South Dakota

29,610 km² (11,430 mi²)

Land use: Most of this area is in farms and ranches. Urban expansion is limited. The area is used mainly for livestock production and cash-grain farming. Alfalfa, sorghum, and hay are the principal crops grown for livestock feed. Winter wheat is the main cash crop. Dry-farming soils not suited to cultivation is destroying the native grassland.

Elevation and topography: Elevation ranges from 400 to 500 m on the bottom land of the Missouri River to 500 to 900 m on the shale plain uplands. The areas that are cropped are mainly at elevations of about 500 to 800 m. These areas are nearly level to rolling and have long smooth slopes and a well-defined dendritic drainage system. River and creek valleys have smooth floors and steep walls.

Climate: *Average annual precipitation*—375 to 475 mm. Most of the precipitation falls during the growing season. Precipitation in winter is mostly snow. *Average annual temperature*—7 to 9°C. *Average freeze-free period*—130 to 160 days.

Water: In most years precipitation is inadequate for maximum plant growth. The reservoirs on the Missouri River are prominent features on the eastern border. There are few shallow-water developments, and most water for livestock comes from surface runoff that flows into dams or from deep artesian flows.

Soils: Most of the soils are Ustolls and Orthents. They are fine textured and very fine textured and have a mesic temperature regime and montmorillonitic mineralogy. The nearly level to rolling, well drained, moderately deep and deep Haplustolls (Promise and Boyd series), Argiustolls (Millboro and Reliance series), Camborthids (Swanboy series), and Ustochrepts (Boro, Lakoma, and Labu series) are on uplands. Shallow Ustorthents (Okaton and Sansarc series) are on the steeper slopes. Poorly drained Haplaquolls (Kolls series) are in upland depressions.

Potential natural vegetation: This area supports a transition between mixed and true prairie vegetation. Green needlegrass, western wheatgrass, needle-and-thread, porcupinegrass, little bluestem, and big bluestem are the major species. The bluestems and sideoats grama are dominant on the thin and shallow soils. Bur oak, buffaloberry, and prairie rose are common on slopes along the major streams.

63B—Southern Rolling Pierre Shale Plains

South Dakota and Nebraska
28,400 km² (10,970 mi²)

Land use: Most of this area is in farms and ranches. Urban expansion is limited. The area is used mainly for livestock production and cash-grain farming. Alfalfa, sorghum, and hay are the principal crops grown for livestock feed. Winter wheat, grain sorghum, and corn are the main cash crops.

Elevation and topography: Elevation ranges from 400 to 500 m on the bottom land of the Missouri River to 400 to 600 m on the shale plain uplands. The areas that are cropped are mainly at elevations of about 500 m. These areas are nearly level to rolling and have long smooth slopes and a well-defined dendritic drain-

age system. Rivers and creek valleys have smooth floors and steep walls.

Climate: *Average annual precipitation*—475 to 600 mm. Most of the precipitation falls during the growing season. Precipitation in winter is mostly snow. *Average annual temperature*—8 to 10°C. *Average freeze-free period*—135 to 160 days.

Water: In most years precipitation is inadequate for maximum plant growth. The reservoirs on the Missouri River are prominent features on the eastern border. There are few shallow-water developments, and most water for livestock comes from surface runoff that flows into dams or from deep artesian flows.

Soils: Most of the soils are Ustolls and Orthents. They are fine textured and very fine textured and have a mesic temperature regime and montmorillonitic mineralogy. Nearly level to rolling, well drained, moderately deep and deep Haplustolls (Opal and Promise series), Camborthids (Pierre, Kyle, and Swanboy series), and Ustochrepts (Lakoma series) are on uplands. Shallow Ustorthents (Okaton and Sansarc series) and Torriorthents (Samsil series) are on the steeper slopes. Poorly drained Haplaquolls (Kolls series) are in upland depressions. Well drained Argiustolls (Canning and Ree series) are on isolated high terraces along rivers and creeks. Ustifluvents (Munjon series) and Torrifluvents (Glenerg and Haverson series) are on the bottom land of major streams.

Potential natural vegetation: This area supports mixed prairie vegetation. Western wheatgrass, green needlegrass, and blue grama are the major species. Little bluestem and sideoats grama are dominant on the shallow soils. Buffaloberry, skunkbush sumac, and prairie rose are common on steep slopes along the major streams.

64—Mixed Sandy and Silty Tableland

Nebraska, South Dakota, and Wyoming
28,400 km² (10,970 mi²)

Land use: Most of this area is in ranches and farms. About three-fifths of the area is rangeland grazed primarily by livestock. The scenic Pine Ridge, an escarpment extending in a general east-west direction in the north-central part of the area, has grassed areas and pine trees of commercial value. Nearly one-third of the area is cropland. South of Pine Ridge, the major enterprise is cash-grain farming, and winter wheat is the main crop. In other parts of the area, feed and forage for livestock are the main crops. Corn and sugar beets are irrigated crops in places where the supply of water is adequate and the soils are suitable.

Elevation and topography: Elevation ranges from 900 to 1,200 m, increasing gradually from east to

west. The nearly level to gently sloping tableland south of the narrow, steep-walled valleys of Pine Ridge has the highest elevation. The topography north of the Pine Ridge escarpment is strongly sloping but becomes less sloping as distance from the escarpment increases. Local relief is mainly in meters, but at Pine Ridge relief is in tens of meters.

Climate: *Average annual precipitation*—375 to 450 mm. Maximum precipitation is during the freeze-free period. Precipitation in winter is snow. *Average annual temperature*—7 to 9°C. *Average freeze-free period*—About 140 days.

Water: Most of the area depends on the rather low and erratic precipitation for water. Ground water is scarce and of poor quality in most of the area. Locally, mainly south of Pine Ridge, underground sand and gravel yield moderate to large quantities of good-quality water.

Soils: Most of the soils are Ustolls. They are medium textured and formed in loess or in alluvium. They have a mesic temperature regime and mixed mineralogy. The nearly level to strongly sloping, deep Argiustolls (Alliance, Kadoka, Keith, Manter, Richfield, and Rosebud series) are on uplands. The nearly level to steep, deep Haplustolls (Bridget series) are on foot slopes. Shallow Torriorthents (Canyon, Epping, Keota, and Tassel series) are on ridges and sides of upland drainageways. Deep sandy Torripsamments (Valent series) are in eolian sand deposits.

Potential natural vegetation: This area supports a mixture of short, mid, and tall grasses. Blue grama, western wheatgrass, threadleaf sedge, sideoats grama, little bluestem, prairie sandreed, switchgrass, sand bluestem, and needleandthread are the major species. On Pine Ridge, these plants grow in association with ponderosa pine, eastern redcedar, western snowberry, skunkbush sumac, common chokecherry, and rose.

65—Nebraska Sand Hills

Nebraska and South Dakota
56,810 km² (21,930 mi²)

Land use: Nearly all this area is in large ranches, most of which is in native grass grazed by livestock. Tracts along the streams and subirrigated valleys are used largely for hay, and the rolling hills and dry valleys are grazed. Use of sprinkler irrigation has increased in recent years. Corn is the principal irrigated crop.

Elevation and topography: Elevation ranges from 600 to 1,200 m, increasing gradually from east to west. Most of this area consists of rolling to steep, irregular sand dunes stabilized by grass vegetation and of narrow elongated, nearly level to gently sloping valleys between the sand dunes. Sand dunes and narrow valleys commonly extend for several miles in a northwest-southeast direction. There are

many scattered small, level depressions. Streams are few, but there are many small permanent and intermittent lakes. The height of the dunes ranges from meters to tens of meters.

Climate: *Average annual precipitation*—425 to 575 mm. About three-fourths of the precipitation falls from midspring to midautumn. Precipitation in winter is snow. *Average annual temperature*—9 to 11°C. *Average freeze-free period*—140 to 150 days.

Water: Precipitation is the source of water for range vegetation. The many small lakes, ponds, and a few streams provide water for livestock and for domestic requirements. Ground water is abundant and of good quality. In most places, water is available for irrigation.

Soils: Most of the soils are Psamments. They are deep, sandy soils that formed in eolian sand. They have a mesic temperature regime, an ustic moisture regime, and mixed mineralogy. Excessively drained Ustipsamments (Valentine series) are on stabilized sand dunes. Well drained Haplustolls (Dunday series) are in the dry valleys. Somewhat poorly drained Haplustolls (Elsmere series) are in subirrigated valleys. Poorly drained and very poorly drained Haplaquolls (Gannett and Loup series) are in depressions between the dunes and along the bottom land of larger streams.

Potential natural vegetation: This area supports mid and tall grass plant communities. Little bluestem, sand bluestem, prairie sandreed, switchgrass, indiangrass, sand lovegrass, and needleandthread are major species on uplands. Big bluestem, switchgrass, indiangrass, prairie cordgrass, and various sedges and rushes grow on sites having a high water table.

66—Dakota-Nebraska Eroded Tableland

Nebraska and South Dakota
12,400 km² (4,800 mi²)

Land use: Most of this area is in native grasses that are grazed by cattle. Some of the smoother parts of the area are used for growing crops, mainly corn, forage and grain sorghum, and alfalfa for livestock feed. In a few cultivated sections, winter wheat is grown as a cash crop.

Elevation and topography: Elevation ranges from 600 to 900 m. The higher parts of the tableland are nearly level to moderately sloping, but steeper sections are on the sides of ridges and drainageways. Drainages are well defined except in some undulating areas where eolian sandy materials mantle the bedrock.

Climate: *Average annual precipitation*—450 to 550 mm. Most of the precipitation falls during the growing season. Precipitation in winter is mainly snow that ranges from about 60 to 100 cm. *Average annual*

temperature—8 to 10°C. Summers are hot, and winters are cold. *Average freeze-free period*—130 to 160 days.

Water: The limited precipitation makes farming a risk, and maximum crop production is not expected in most years. The Niobrara River is the only perennial stream. Throughout most of the area, shallow water is available in quantities sufficient for livestock and domestic uses. Most soils are deficient in moisture during much of the latter part of the growing season.

Soils: Most of the soils are Ustolls. They are moderately deep and deep, well drained and moderately well drained, and medium textured and moderately coarse textured. These soils have a mesic temperature regime, an ustic moisture regime, and mixed mineralogy. The nearly level to sloping Argiustolls (Holt, Kadoka, Paka, Reliance, and Tuthill series) and Haplustolls (Anselmo and Vetal series) are on uplands. The moderately steep to steep Ustorthents (Okaton series) and Torriorthents (Tassel series) are on the sides of draws, on high ridges, and along drainageways. Deep sandy Haplustolls (Doger, Dunday, and Elsmere series) and Ustipsamments (Valentine series) are in areas of eolian deposits. Ustifluvents (Inavale series) and Fluventic Haplustolls (Cass series) are along the drainages.

Potential natural vegetation: This area supports mixed prairie vegetation. Little bluestem, prairie sandreed, green needlegrass, and needleandthread are dominant species. Sideoats grama and plains muhly are important species on the shallow soils. Leadplant and prairie rose grow on the sides of draws.

67—Central High Plains

Colorado, Nebraska, and Wyoming

74,410 km² (28,730 mi²)

Land use: Most of this area is in farms and ranches, but land near Denver and other cities along the western edge is being converted to urban use. About three-fifths is in range of native short and mid grasses grazed by cattle and sheep. About one-fourth is dry-farmed to wheat and other grains. An extensive acreage is irrigated. Corn, alfalfa, sugar beets, and vegetables are the major irrigated crops. Wet soils on flood plains are in meadows used for hay or pasture.

Elevation and topography: Elevation ranges from 1,100 to 1,800 m, increasing gradually from east to west. These undulating to rolling plains have been moderately dissected by streams. Steep slopes border the valleys of the larger streams and also the edges of isolated mesas. The dunes bordering some of the valleys have rolling to hilly irregular topography. Local relief is mainly in meters to tens of meters.

Climate: *Average annual precipitation*—325 to 425 mm. Maximum precipitation is in midspring and late in autumn. *Average annual temperature*—7 to 10°C in most of the area, increasing to 13°C in the extreme south. *Average freeze-free period*—120 to 160 days in most of the area but as long as 180 days in the extreme south.

Water: Water for range vegetation and dryfarming is provided by the low and erratic precipitation. In much of the area, sand and gravel yield adequate quantities of ground water for livestock and for domestic and other uses. In areas where shale bedrock is near the surface, ground water is scarce and commonly of poor quality. Irrigation water is obtained mostly from the larger rivers, but locally wells provide some irrigation water.

Soils: Most of the soils are Ustolls and Argids. They are deep and medium textured and fine textured and have mixed or montmorillonitic mineralogy. They have an aridic moisture regime that is borderline to ustic and a mesic temperature regime. The nearly level to gently sloping, fine Paleustolls (Weld and Platner series) and loamy Haplargids (Fort Collins and Vona series) on uplands formed in eolian and alluvial materials under a cover of grass. Torriorthents, Haplustolls, and Argiustolls are the major included soils.

Potential natural vegetation: This area supports short and mid grass prairie vegetation. Blue grama with pricklypear, buffalograss, western wheatgrass, threeawn, and sand dropseed are the major species. Cottonwood is common along the major drainageways.

69—Upper Arkansas Valley Rolling Plains

Colorado

34,000 km² (13,130 mi²)

Land use: Nearly all this area is in farms and ranches. Almost three-fourths is in native short grasses used for grazing. Flood plains and terraces along the Arkansas River, making up 5 to 10 percent of the area, are irrigated. Alfalfa, sugar beets, grain sorghum, melons, seed crops, corn, small grains, onions, and other vegetables are the chief crops. Land that is flooded frequently and soils that are strongly affected by salts are used for grazing. Between 5 and 10 percent of the area is dry-farmed. Winter wheat, dry beans, and grain sorghum are the main crops.

Elevation and topography: Elevation ranges from 1,100 to 1,900 m, increasing gradually from east to west. In many places, these undulating to rolling shale plains are mantled by loess or windblown sand, alluvium, and outwash. Wide bands of steep slopes border several of the larger tributaries of the Arkansas River. Local relief is mostly less than 25 m but is as much as 50 m in some of the rough broken areas.

Climate: *Average annual precipitation*—250 to 375 mm, but it fluctuates widely from year to year. *Maximum precipitation* is from midspring through late autumn. *Average annual temperature*—10°C. *Average freeze-free period*—140 to 160 days.

Water: The low and erratic precipitation is the source of water for range vegetation. The Arkansas River and one or two of its larger tributaries provide water for irrigation along their valleys. In much of the area, ground water in the deeper sand and gravel provides water for livestock and for domestic uses, and locally it provides some water for irrigation. Ground water is scarce in a large part of the area where shale is near the surface.

Soils: Most of the soils are Argids. They are deep and medium textured to fine textured. These soils have mixed or montmorillonitic mineralogy, an aridic moisture regime that is marginal to ustic, and a mesic temperature regime. The nearly level to gently sloping Haplargids (Baca, Wiley, and Olney series) are extensive on uplands. They formed in loess and local eolian deposits under short grass vegetation. Also extensive are shallow and moderately deep Torriorthents that formed mainly on sedimentary rocks without a loess cover.

Potential natural vegetation: This area supports short grass prairie vegetation. Blue grama with galleta, cholla, threeawn, ring muhly, and alkali sacaton are the major species. Cottonwood is common along the major streams. Stony and rocky soils support a mixed stand of pinyon and juniper with understory species similar to those in nearby openings and grasslands.

70—Pecos-Canadian Plains and Valleys

Colorado and New Mexico

84,830 km² (32,750 mi²)

Land use: Most of this area is in farms, ranches, or other private holdings. About 10 percent is federally owned. More than three-fourths of the area is in range, and cattle and sheep grazing is the principal enterprise. Some of the northern and eastern slopes of the high mesas in the north are covered by forest vegetation, but the total forested area is small. About 3 percent of the area is cropland. In places where moisture supplies are favorable, mainly in the west and north, the deeper soils are dry-farmed. Beans, small grains, and grain sorghum are the principal crops. Some hay is also grown, and some land is in pasture. Small tracts in some of the valleys and on the uplands are irrigated with water from wells and from reservoirs. Forage crops and feed grains are the principal crops.

Elevation and topography: Elevation ranges from 1,200 to 2,100 m, increasing gradually from southeast to northwest, but it is 2,400 m on a few mesas and

mountains. Most of these dissected high plains are gently sloping to rolling, but bands of steep slopes and rough broken land border the stream valleys. A few isolated mountains, mesas, and canyon walls have steep to very steep slopes. Valley floors are mostly narrow and cut by stream channels. Local relief is mainly in meters but is as much as 100 m in some of the rough broken areas.

Climate: *Average annual precipitation*—300 to 400 mm, but it fluctuates widely from year to year. *Maximum precipitation* is from late in spring to early in autumn. *Average annual temperature*—10 to 16°C. *Average freeze-free period*—135 to 200 days, decreasing from southeast to northwest.

Water: Water is scarce throughout the area because of the low and erratic precipitation and the few perennial streams. Ground water in deep sand and gravel in the north and from limestone in the southern two-thirds of the area provides water for domestic use and for livestock, and locally it provides water for irrigation. Ground water is scarce in areas where shale and sandstone are near the surface.

Soils: Most of the soils are Orthids, Argids, and Ustolls. They are well drained and moderately fine textured to moderately coarse textured and have mixed mineralogy. In the north and in the west, these soils have a mesic temperature regime and in the south and in the east a thermic temperature regime. They have an ustic or aridic moisture regime. Deep Calciorthids (Harvey, Dean, Quay, and San Jon series on upland alluvial fans and Bascom series on uplands) are nearly level to strongly sloping. Shallow Calciorthids (Pinon series) on low limestone ridges and hills are strongly sloping to moderately steep. Deep Haplargids (Penistaja, Clovis, Witt, Tapia, Redona, and Canez series) on uplands are nearly level to undulating. Deep Camborthids (La Fonda, La Lande, and Ima series) on upland alluvial fans are level to moderately sloping. Argiustolls are deep (Rednun, La Brier, and Torreón series) and moderately deep (Carnero series) in depressions and on uplands and shallow (Bernal series) on mesa tops and upland ridges. Haplustolls are deep (Manzano and Colmor series) on valley floors and alluvial fans and shallow (Apache and Laporte series) on uplands. Shallow Calciustolls (Deama and Ector series) on limestone hills and ridges are strongly sloping to moderately steep. Paleorthids (Pastura and Blakeney series) and Paleargids (Douro series) are on uplands. Moderately sloping to steep, shallow Torriorthents (Travessilla and Penrose series) are on ridges, and deep Torriorthents (Lacita and Otero series) are on valley floors and uplands. Torrerts (Montoya series) are on valley floors.

Potential natural vegetation: This area supports plains grassland vegetation that is dominantly short and mid grasses. Blue grama is the dominant species.

Western wheatgrass is the associated species in the northern part of the area. Lesser amounts of blue grama in association with black grama, galleta, New Mexico feathergrass, and a variety of shrubs, half shrubs, and forbs characterize the southern part.

Scattered juniper and pinyon with an understory of sideoats grama, bottlebrush squirreltail, and western wheatgrass grow on shallow soils and in escarpments. Ponderosa pine grows on north and east slopes of the high mesas.

H—CENTRAL GREAT PLAINS WINTER WHEAT AND RANGE REGION

575,720 km² (222,280 mi²)

The soils, topography, and climate in this region are more favorable for agriculture than those in the Great Plains to the north and west. A longer freeze-free season in the Central Great Plains permits a greater variety of crops to be grown. The average annual precipitation is 500 to 750 mm in much of this region but ranges from 375 to 900 mm, increasing from northwest to southeast. More rain falls during the summer than during the other seasons. The average annual temperature is 10 to 18°C, increasing from north to south. The freeze-free period is 170 to 180 days in most of this region but ranges from 140 to 240 days, increasing in length from north to south.

Ustolls are the dominant soils. Orthents on steep slopes, Psammments in deep sands, and Fluvents on flood plains are common throughout the region.

Cash-grain farming is the major agricultural enterprise on most of the better soils, and wheat is the principal crop. In the northern part along the Platte River, corn and alfalfa are grown extensively under irrigation. In the south, where the freeze-free period exceeds 200 days, cotton is grown extensively under irrigation. Irrigation water is obtained from wells. Steeply sloping, shallow, and sandy soils are used for range.

71—Central Nebraska Loess Hills

Nebraska

26,220 km² (10,120 mi²)

Land use: Nearly all this area is in farms and ranches, and almost two-fifths is dry-farmed. About one-half of the area is in native grasses used for grazing. Winter wheat, grain sorghum, and alfalfa are the major dry-farmed cash crops. Between 5 and 10 percent of the area, consisting of flood plains and terraces along the Platte River and its larger tributaries, is irrigated. Corn, alfalfa, and seed crops are the principal irrigated crops. Alfalfa is commercially grown in the Platte River Valley. Vegetables are commercially grown on some of the mixed sandy and silty soils.

Elevation and topography: Elevation ranges from 500 to 800 m, increasing from east to west. Nearly level to gently sloping loess-mantled narrow ridgetops are separated by steep slopes bordering drainageways. Some stream valleys have nearly level flood plains and large stream terraces. Nearly level soils on high stream terraces are in the southern part of the area in the Platte River Valley. Local relief is in meters to tens of meters.

Climate: *Average annual precipitation*—500 to 625 mm. Most of the precipitation falls from spring through autumn, but the maximum is from late in spring to early in summer. *Average annual temperature*—About 11 to 12°C. *Average freeze-free period*—150 to 160 days, increasing from west to east.

Water: In most of the area, the low erratic precipitation is the source of water for crops and native grasses. The larger rivers provide water for irrigation along their valleys. In much of the area, good-quality ground water is abundant for domestic and livestock needs and is used locally for irrigation. Gravity irrigation is practiced extensively on bottom

lands and stream terraces of the Platte River and other larger streams.

Soils: Most of the soils are Ustolls. They are deep silty soils that formed in loess. They have a mesic temperature regime, an ustic moisture regime, and mixed mineralogy. The nearly level to strongly sloping Argiustolls (Holdrege series) are extensive on ridgetops. Steep, silty Ustorthents (Coly series) are on breaks along drainageways. Argiustolls (Hall series) and Haplustolls (Hord series) are on stream terraces. Ustifluvents (Hobbs series) are extensive on flood plains. Fine sandy loam Haplustolls (Anselmo series) are in the zone transitional to the Sand Hills.

Potential natural vegetation: This area supports short, mid, and tall grass plant communities on the uplands. Big bluestem, little bluestem, switchgrass, indiagrass, sideoats grama, blue grama, and western wheatgrass are major species on silty soils. Needleandthread, prairie sandreed, sand bluestem, little bluestem, and blue grama are major species on sandy soils.

72—Central High Tableland

Colorado, Kansas, and Nebraska

77,220 km² (29,810 mi²)

Land use: Nearly all this area is in farms and ranches, and three-fifths or more is cropland. This is a major dryfarming area. Winter wheat is the main cash crop, but large acreages are planted to other small grains, grain sorghum, alfalfa, and other hay crops. Many crops are grown on the narrow bands of irrigated land along the Platte, Republican, and Arkansas Rivers. Corn, grain sorghum, and sugar beets are grown extensively on the nearly level uplands where ground water is used for irrigation. One-third or more of the area, consisting of hilly and steep slopes bordering drainageways, is in native grasses and shrubs used for grazing.

Elevation and topography: Elevation ranges from 800 to 1,200 m, increasing from east to west. On this smooth loess-mantled tableland, slopes are mostly nearly level to gently rolling, but the major valleys are bordered by steep slopes. The Arkansas and Platte Rivers and a few of their larger tributaries have broad level flood plains and terraces. The local relief on uplands is in meters, but valleys are tens of meters below the general level of the upland.

Climate: *Average annual precipitation*—400 to 525 mm, but it fluctuates widely from year to year. Maximum precipitation is from late in spring through early autumn. Precipitation in winter is snow that ranges from about 40 cm annually in the south to 90 cm in the north. *Average annual temperature*—10 to 14°C. *Average freeze-free period*—140 to 185 days, increasing from northwest to southeast.

Water: The low and erratic precipitation is the source of water for dryland crops and pastures on uplands. Irrigation water obtained from the Arkansas, Republican, and Platte Rivers is used along the valleys of these rivers. In most of the area, good-quality ground water is adequate for domestic and livestock needs and is used locally for irrigation. Ground water is scarce in areas where shale is near the surface.

Soils: Most of the soils are Ustolls. They are well drained and medium textured and moderately fine textured. They have a mesic temperature regime, an ustic moisture regime, and mixed or montmorillonitic mineralogy. On loess-mantled uplands, well drained Argiustolls (Keith, Kuma, Rago, and Richfield series) are in nearly level and gently sloping areas, Haplustolls (Ulysses series) in gently sloping and moderately sloping areas, and Torriorthents (Colby series) in steeper areas. Torriorthents (Canyon series) and Ustorthents (Canlon series) are shallow over caliche and are on the steeper and more broken slopes. Torripsamments (Valent series), on hummocky and duned eolian sands, are associated with Argiustolls (Haxtun series) and Haplustolls (Anselmo series). Haplustolls (Bridgeport, McCook, and Duroc series) are on flood plains and terraces.

Potential natural vegetation: This area supports a short grass prairie vegetation. Blue grama and buffalograss are the dominant species. Sideoats grama, blue grama, hairy grama, and little bluestem grow on the steeper dissected areas.

73—Rolling Plains and Breaks

Kansas and Nebraska
59,260 km² (22,880 mi²)

Land use: Nearly all this area is in farms, and about three-fifths is dry-farmed cropland. Winter wheat and grain sorghum are the major crops in much of the area, but corn is important in the north. Feed grains and hay are other major crops. About 2 percent of the area, mostly narrow bands of bottom land and terraces along the Republican and Platte Rivers and

their major tributaries, is irrigated. Corn, alfalfa, small grains, and hay are the principal crops grown on irrigated land, but some potatoes and vegetables are grown. One-third or more of the area is in native grasses used for grazing.

Elevation and topography: Elevation ranges from 500 to 900 m, increasing from east to west. These dissected plains have broad undulating to rolling ridgetops and hilly to steep valley sides. The valleys generally are narrow, but the Republican River and its larger tributaries have broad flood plains and terraces. Local relief is in meters to tens of meters.

Climate: *Average annual precipitation*—500 to 625 mm. Maximum precipitation is from midspring to early in autumn. Precipitation in winter is snow that ranges from about 45 cm annually in the south to 60 cm in the north. *Average annual temperature*—10 to 13°C. *Average freeze-free period*—150 to 180 days, increasing from northwest to southeast.

Water: In most of the area, the moderate and erratic precipitation is the source of water for crops and pasture. The Republican and Platte Rivers and their larger tributaries provide water for irrigation along their valleys. Abundant supplies of ground water for irrigation and other uses are obtained from deep wells in the north. Ground water is scarce in the south where shale and limestone are near the surface.

Soils: Most of the soils are Ustolls. They are deep, well drained, and medium textured and moderately fine textured. These soils have a mesic temperature regime, an ustic moisture regime, and mixed and montmorillonitic mineralogy. The nearly level to moderately sloping Argiustolls (Harney and Holdrege series) are on loess-mantled uplands. Haplustolls (Uly series) and Ustorthents (Coly series) are on adjacent steeper slopes. Gently sloping and moderately sloping Haplustolls (Wakeen series) and Pellusterts (Bogue series) are moderately deep over shale on the more strongly dissected uplands. Haplustolls (Hord, McCook, and Roxbury series) and Ustifluvents (Hobbs and Munjor series) are on flood plains and terraces.

Potential natural vegetation: This area supports natural prairie vegetation. Little bluestem, big bluestem switchgrass, western wheatgrass, and sideoats grama characterize the vegetation on loamy soils. Blue grama, buffalograss, and western wheatgrass characterize the vegetation on clayey soils on uplands.

74—Central Kansas Sandstone Hills

Kansas
12,210 km² (4,710 mi²)

Land use: Most of this area is in farms, more than one-half of which is cropland. Winter wheat is the principal crop. Grain sorghum, hay, small grains, and corn are other important crops. Some land along the

large rivers is irrigated. The crops grown in non-irrigated areas are also grown under irrigation, but more corn and less wheat is grown under irrigation. About one-third of the area is in native grasses grazed by cattle.

Elevation and topography: 400 to 500 m, increasing from east to west. Local relief on this undulating to hilly dissected plain is in tens of meters. The larger rivers have wide flood plains and terraces, but the small streams have narrow bottom lands.

Climate: *Average annual precipitation*—625 to 700 mm. Most of the precipitation falls from spring through autumn, but the maximum is in midsummer. Annual snowfall averages about 50 cm. *Average annual temperature*—12 to 13°C. *Average freeze-free period*—170 to 180 days.

Water: If moisture is carefully conserved, the moderate precipitation generally is adequate for crops and pasture. The larger streams can supply water for irrigation, but most of them have not been used for this purpose. Ground water is adequate to meet domestic and livestock needs in most of the area and is used locally for irrigation. Ground water is scarce in the east where shale is near the surface.

Soils: Most of the soils are Ustolls. They are shallow to deep and medium textured and moderately fine-textured. They have a mesic temperature regime, an ustic moisture regime, and mixed and montmorillonitic mineralogy. The nearly level and gently sloping, well drained and moderately well drained Argiustolls are on loess-mantled uplands (Crete, Smolan, and Longford series) and on side slopes and foot slopes in dissected areas (Lancaster and Geary series). The moderately steep and hilly, shallow Haplustolls (Hedville series) are over sandstone on uplands. Ustifluvents (Hobbs series) are on flood plains of the smaller streams. Haplaquolls (Solomon series) and Haplustolls (Sutphen, Roxbury, and New Cambria series) are on bottom lands of major streams.

Potential natural vegetation: This area supports mid and tall grasses. Little bluestem, big bluestem, switchgrass, sideoats grama, and western wheatgrass are major species.

75—Central Loess Plains

Kansas and Nebraska

34,840 km² (13,450 mi²)

Land use: Nearly all this area is in farms, about two-thirds of which is cropland. Hard winter wheat and grain sorghum are the main cash crops, but large acreages are planted to other small grains and hay. Corn is a major cash crop in the north. Most of the corn is irrigated by water from wells or canals. About one-fourth of the land is rangeland or pastureland grazed by beef cattle.

Elevation and topography: Elevation ranges from 500 to 600 m, increasing from east to west. Most of these nearly level to gently rolling plains are mantled

by loess, but the part south of central Kansas is underlain by unconsolidated sediments, soft sandstone, and shale. The present drainage pattern cuts into the upper loess mantle and in places exposes the older Loveland loess. Stream valleys are mostly narrow and are not deeply incised. Relief is in meters to tens of meters.

Climate: *Average annual precipitation*—625 to 750 mm. Maximum precipitation is from midspring to midautumn. The low winter precipitation is snow. *Average annual temperature*—10 to 14°C, increasing from north to south. *Average freeze-free period*—160 to 190 days.

Water: The moderate but somewhat erratic precipitation is the source of water for grain crops, native grasses, and pasture. In the northwest, the Platte River supplies some water for irrigation. Ground water that is hard but otherwise of good quality is abundant in the sand and gravel underlying part of the area. Adequate quantities of ground water are available for irrigation in the northern part. Ground water is scarce in areas where shale and clay are near the surface.

Soils: Most of the soils are Ustolls. They are deep silty soils that formed in loess. They have a mesic temperature regime, an ustic moisture regime, and mixed mineralogy. Argiustolls (Hastings, Geary, Holder, Holdrege, and Crete series in the north and Irwin, Ladysmith, and Geary series in the south) are the dominant soils on uplands. Argiustolls (Hall series) are on stream terraces of major streams or rivers. Argiaquolls (Butler series), Argialbolls (Fillmore series), and Pellusterts (Goessel series) are associated soils in level areas and in depressions. Strongly sloping to steep Ustorthents (Coly series) formed in loess. Ustifluvents (Hobbs series) are on flood plains, and Haplustolls (Hord series) are on stream terraces. Shallow, strongly sloping to steep Haplustolls (Kipson series) formed in material weathered from shale.

Potential natural vegetation: This area supports mid and tall grass plant communities. Big bluestem, little bluestem, switchgrass, indiangrass, and sideoats grama characterize the vegetation on silty upland soils. These grasses and western wheatgrass are on bottom lands and in upland basins.

76—Bluestem Hills

Kansas and Oklahoma

19,400 km² (7,490 mi²)

Land use: Nearly all this area is in farms and ranches, about three-fifths of which is in native grasses grazed by beef cattle. Nearly one-fifth of the area, consisting mainly of the deeper soils in valleys and on some of the uplands, is cropland. Some winter wheat is grown as a cash crop. Other small grains, grain sorghum, alfalfa, and other hay are the major crops. These crops are also grown on small irrigated areas along the Arkansas River.

Elevation and topography: Elevation ranges from 300 to 500 m. These dissected limestone and shale uplands have narrow divides and narrow steep-sided valleys. Only a few large streams have a significant area of flood plain. Local relief is commonly in meters or tens of meters.

Climate: *Average annual precipitation*—750 to 900 mm. Maximum precipitation is from midspring through early autumn. Annual snowfall averages 35 to 50 cm. *Average annual temperature*—12 to 16°C. *Average freeze-free period*—170 to 190 days but slightly more than 200 days in the south.

Water: The moderate precipitation provides water for pastures and crops. Much of the water for livestock is stored in small reservoirs and ponds. In the limestone areas, shallow wells yield moderate quantities of good-quality water, but very little is available in areas underlain by shale. Water from deep wells is highly mineralized.

Soils: Most of the soils are Ustolls. They are shallow to deep, medium textured to fine textured soils that are stony in some places. These soils have an ustic moisture regime, a mesic (Kansas) or thermic (Oklahoma) temperature regime, and mixed mineralogy. Well drained and moderately well drained, nearly level to moderately sloping Argiustolls (Irwin, Labette, and Ladysmith series) and Natrustolls (Dwight series) are on clay-mantled uplands that in some places are covered by thin loess. Shallow and moderately deep Haplustolls (Sogn and Clime series) are on steeper slopes underlain by limestone and shale. Moderately sloping Argiustolls (Florence series) in cherty limestone are on narrow divides and on side slopes of broader ridges. Haplaquolls (Osage series) and Hapludolls (Ivan and Verdigris series) are on flood plains, and Argiudolls (Reading series) and Haplustolls (Muir series) are on terraces.

Potential natural vegetation: This area supports tall grass prairie vegetation. Big bluestem, indiangrass, switchgrass, and little bluestem are dominant species. Little bluestem and big bluestem grow on the shallow soils.

77—Southern High Plains

Kansas, New Mexico, Oklahoma, and Texas

126,780 km² (48,950 mi²)

Land use: Almost all this area is in farms and ranches. More than two-fifths, consisting of breaks along the Canadian and Cimarron Rivers and their larger tributaries and areas of sandy soils in the southwest, is range of native grasses and shrubs grazed by beef cattle. About one-third of the area, the smooth uplands, is dry-farmed to winter wheat, grain sorghum, and cotton. Nearly one-fifth of the area is irrigated. Wheat and grain sorghum are the major crops south of the Canadian River. Other major crops

grown in places where irrigation water is available include soybeans, corn, alfalfa, and vegetables.

Elevation and topography: Elevation ranges from 800 to 2,000 m, increasing gradually from southeast to northwest. These smooth high plains are gently sloping, but along the major rivers, breaks are very steep. The deep sand in the southwest has an irregular dune topography. Local relief is in meters, but the major valleys are tens of meters below the general level.

Climate: *Average annual precipitation*—375 to 550 mm, but it fluctuates widely from year to year. Maximum precipitation is from late in spring through autumn. The low precipitation in winter is mainly snow. *Average annual temperature*—13 to 17°C. *Average freeze-free period*—130 to 220 days, increasing from north to south and from west to east.

Water: The moderately low and erratic precipitation is the source of water for dry-farmed crops and for range. Perennial streams are few; they fluctuate widely in flow from year to year and are little used for irrigation. Sand and gravel throughout the central and northern parts of the area yield an abundance of ground water. Irrigation water is obtained from wells, but in the central and southern parts withdrawals exceed recharge, and the water table is gradually declining. Some areas formerly irrigated are now dry-farmed.

Soils: Most of the soils are Ustolls and Ustalfs. They are deep, fine, and medium textured and coarse textured. These soils have a mesic or thermic temperature regime, an ustic moisture regime, and mixed or carbonatic mineralogy. The level to gently sloping Paleustolls (Pullman, Olton, Acuff, Sherm, Gruver, Texline, and Dumas series), Argiustolls (Richfield series), Paleustalfs (Amarillo, Dallam, Rickmore, and Spurlock series), and Haplustalfs (Dalhart series) are the principal soils on the uplands. Calciustolls (Portales and Dioxice series), Haplustolls (Ulysses series) and Paleustolls (Mansker, Conlen, Sunray, and Estacado series) are dominant on ridges and on the more sloping parts. Haplustolls (Bippus, Humbarger, and Spur series) are on young valley floors and flood plains of the streams. Pellusterts (Randall and Ness series) are in clayey playa lake basins. Shallow Calciorthids (Potter series), Paleorthids (Pastura series), and Torriorthents (Travessilla series) are on the steep slopes and in the breaks. Paleustalfs (Patricia, Springer, and Brownfield series), Haplargids (Triomas, Faskin, and Jalmar series), Ustipsamments (Tivoli series), and Torripsamments (Penwell series) are deep sandy soils in the southwest. Loamy, shallow to moderately deep soils in the southwest are Calciustolls (Kimbrough series), Paleustolls (Lea, Slaughter, and Stegall series), Paleustalfs (Arvana series), Paleorthids

(Blakeney and Conger series), and Paleargids (Douro and Sharvana series).

Potential natural vegetation: This area supports a short grass community characterized by blue grama and buffalograss. Mid grasses such as sideoats grama grow on the more open soils and breaks. Tall grasses such as sand bluestem, little bluestem, and indiangrass grow mixed with shinnery oak and sand sagebrush on the sandy soils. A wide range of perennial forbs grow on the sandier soils and are characterized by dotted gayfeather, pitchersage, sagewort, bushsunflower, and daleas.

78—Central Rolling Red Plains

Kansas, Oklahoma, and Texas

130,370 km² (50,340 mi²)

Land use: About 60 percent of this area is rangeland, and 35 percent is cropland. The rest of the area is urban land, woodland, or pasture. Nearly all the area is in farms or ranches. Most rangeland is in the west, but some is throughout the area. Ranges and pastures are grazed mainly by beef cattle. Winter wheat and grain sorghum are the major cash crops grown throughout the area. Cotton is an important crop south of the Cimarron River; alfalfa and peanuts are important locally. The crops grown under irrigation are also grown in nonirrigated areas. Soil erosion is a major concern of management if the soils are cultivated or if range and pasture are overgrazed.

Elevation and topography: Elevation ranges from 500 to 900 m, increasing gradually from east to west. On these dissected plains, the broad divides are nearly level to gently sloping, but slopes are short and steep in the valleys. In places the valleys are bordered by a rolling to steep irregular dune topography. Local relief is mainly in meters, but a few of the larger valleys are tens of meters or more below the general level of the plain. In southwestern Oklahoma, the Wichita Mountains are as much as 300 m above the surrounding plains.

Climate: *Average annual precipitation*—500 to 750 mm, increasing from west to east. Maximum precipitation is in spring, and the minimum is in winter. Snowfall ranges from 25 cm in the north to 10 cm in the south. *Average annual temperature*—14 to 18°C. *Average freeze-free period*—185 days to 230 days.

Water: The moderate but somewhat erratic precipitation supplies water for range and crops. Small ponds on individual farms provide water for livestock. Some larger ponds on individual farms are used for flood control, recreation, irrigation water, or water for livestock. A few large ponds and reservoirs are a source of municipal water and irrigation water. Rivers are a potential source of water for irrigation. Water in some of the larger rivers is highly mineralized. The deep sand and gravel in valleys yield some

ground water. In sloping areas where the underlying sandstone and shale are near the surface, ground water is scarce.

Soils: The major soils are Ustolls, Ustalfs, and Ochrepts. They have a thermic temperature regime, an ustic moisture regime, and mixed mineralogy. The nearly level to gently sloping, well drained and moderately well drained, deep Argiustolls (Abilene, Carey, and St. Paul series), Paleustolls (Hollister, Rotan, Sagerton, and Tillman series), and Natrustolls (Foard series) are on uplands. The Ustalfs mainly are deep and sandy or loamy and have a loamy subsoil. They have a thermic temperature regime and mixed mineralogy. The nearly level to undulating or rolling, well drained, deep Haplustalfs (Devol and Grandfield series) and Paleustalfs (Miles, Springer, Wichita, Winters, and Nobscot series) are on uplands. The gently sloping to moderately steep Ustochrepts (Dill, Enterprise, Hardeman, Obaro, Quinlan, Vernon, and Woodward series) are on uplands. Ustifluvents (Clairemont, Lincoln, Mangum, Yomont, and Yahola series) are minor soils on flood plains.

Potential natural vegetation: This area supports mid and tall grasses. Sand bluestem, little bluestem, and sand sagebrush are dominant on the coarse-textured soils. Little bluestem, gramas, and associated grasses and forbs grow on the finer textured soils.

79—Great Bend Sand Plains

Kansas

10,770 km² (4,160 mi²)

Land use: Nearly all this area is in farms and ranches, and more than two-thirds is cropland. Cash-grain farming is the principal enterprise. Hard winter wheat is the major crop, but grain sorghum and alfalfa are also grown. About one-fifth of the land, consisting of sandy soils and steeply sloping areas, is in native grasses grazed by beef cattle.

Elevation and topography: Elevation ranges from 500 to 800 m. These undulating to rolling plains have a deep mantle of windblown sand and sandy outwash materials. Local relief is mainly in meters.

Climate: *Average annual precipitation*—525 to 700 mm. Maximum precipitation is from late in spring through early autumn. The annual snowfall averages from 35 to 50 cm. *Average annual temperature*—13 to 14°C. *Average freeze-free period*—180 to 190 days.

Water: The source of water for crops and pasture is the moderate but somewhat erratic precipitation. Along the northern edge, the Arkansas River is a potential source of irrigation water but currently is little used for this purpose. Deep sand yields an abundance of good-quality ground water for domestic use, livestock, irrigation, and other purposes.

Soils: Most of the soils are Ustalfs. They are deep, coarse textured and moderately coarse textured soils

that have a thermic temperature regime and an udic moisture regime. Sandy Haplustalfs (Pratt series) and loamy Haplustalfs (Attica series) are on broad undulating to hummocky plains. Ustipsamments (Tivoli series) are on steeper hummocks and dunes. The nearly level and gently undulating, loamy Argiustolls (Farnum and Naron series) are on slopes. The nearly level Argiaquolls (Carwile series) in depressions and in areas with no defined drainage pattern are moderately extensive throughout the area. Haplustolls on flood plains (Waldeck, Zenda, and Lesho series) and terraces (Canadian series) are along major streams.

Potential natural vegetation: This area supports tall grass prairie vegetation. Sand bluestem, little bluestem, switchgrass, and indiangrass are major species. Sand bluestem, little bluestem, and giant sandreed grow on sandy dunes.

80A—Central Rolling Red Prairies

Kansas, Oklahoma, and Texas

52,700 km² (20,350 mi²)

Land use: About 40 percent of this area is rangeland, and 40 percent is cropland. About 20 percent of the area is urban land, woodland, or pasture or is used for other purposes. Nearly all the area is in farms or ranches. Most cropland is in the north, but some is throughout the area. Winter wheat is the major cash crop. Alfalfa, cotton, grain sorghum, peanuts, and soybeans are important crops locally. The range and pasture are grazed mainly by beef cattle, but locally there are some dairy cattle. Soil erosion is a major concern of management if the soils are intensively cultivated or range and pasture are overgrazed.

Elevation and topography: Elevation ranges from 300 to 500 m, increasing gradually from east to west. On this dissected plain, the divides are undulating to gently rolling and the valley sides are hilly and steep. Flood plains of large streams are wide and level and are less dissected by stream channels than those to the west. Local relief is mainly in meters.

Climate: *Average annual precipitation*—625 to 900 mm. Maximum precipitation is in spring and the minimum in winter. Annual snowfall ranges from 30 cm in the north to 10 cm in the south. *Average annual temperature*—14 to 18°C. *Average freeze-free period*—190 to 230 days.

Water: The moderate and somewhat erratic precipitation is the source of water for crops and pasture. Several large rivers that cross the area from west to east are potential sources of irrigation water but currently are little used for this purpose. Small ponds on individual farms provide flood control, recreation, irrigation water, or water for livestock. A few large ponds and reservoirs are a source of municipal water and are also used for recreation. In areas where the valleys have deep sand and gravel, shallow wells provide moderate quantities of water for domestic

use and for livestock. Ground water is scarce and generally is highly mineralized in sloping areas where the underlying sandstone and shale are near the surface.

Soils: The major soils are Ustolls. They are loamy or clayey and have a thermic temperature regime, an ustic moisture regime, and mixed mineralogy. The nearly level to sloping, well drained or moderately well drained, deep or moderately deep Argiustolls (Anocon, Grant, Pond Creek, Tabler, Shellabarger, and Stoneburg series) and Paleustolls (Bethany, Kirkland, and Renfrow series) are on uplands. The nearly level to steep, well drained, shallow to deep Haplustolls (Minco, Nash, and Lucien series) are on uplands. The nearly level, well drained or moderately well drained, deep Haplustolls (Miller, Port, and Reinach series) are on flood plains and low terraces. Minor soils include deep Haplustalfs (Bluegrove, Grainola, Pratt, and Steedman series) on uplands and Ustifluvents (Gaddy, Clairemont, and Yahola series) and Udifluvents (Gracemont and Gracemore series) on flood plains.

Potential natural vegetation: This area supports mixed prairie vegetation. Woody trees and shrubs are in the major drainageways. Indiangrass, big bluestem, switchgrass, and little bluestem are dominant species on the deeper soils and in the valleys. Little bluestem usually is dominant on the uplands and on shallow soils.

80B—Texas North-Central Prairies

Texas

25,500 km² (9,850 mi²)

Land use: Nearly all this area is in ranches and farms. More than 80 percent is native range, pasture, or scrub oak forest. About 15 percent of the area is cropland. Most grassland is grazed by beef cattle. Some rangeland is also grazed by sheep and goats. Valleys, bottom land, and outwash areas of deep soils are farmed to wheat, oats, cotton, and grain sorghum. Hunting leases for deer, quail, and wild turkey are an important source of income in the area. The major concern of management is controlling woody brush that encroaches on the grassland.

Elevation and topography: Elevation ranges from 200 to 700 m. These dissected limestone, sandstone, and shale uplands have broad undulating divides and narrow steep-sided valleys. Only a few large, through-flowing streams have significant flood plains. Relief is mainly in meters, but the large valleys are tens of meters below the adjacent uplands.

Climate: *Average annual precipitation*—550 to 750 mm. Maximum precipitation is in spring and in fall. Summer moisture deficit ranges from 200 to 275 mm. *Average annual temperature*—18 to 19°C. *Average freeze-free period*—214 to 240 days.

Water: The moderate but somewhat erratic rainfall is the source of water for crops and range. Summer droughts are common. The larger rivers, such as the Brazos and Colorado Rivers, flow most of the year, but local streams flow intermittently. There are several large lakes and numerous flood-detention reservoirs in the area. Some rural residents depend on community systems supplied from lakes for water; others depend on private lakes for water. Livestock water comes from streams or ponds. Ground water is scarce.

Soils: Most of the soils are Ustolls, Usterts, Ustalfs, and Ochrepts. These soils are well drained and moderately well drained, somewhat stony, and medium textured to fine textured. They have a thermic temperature regime, an ustic moisture regime, and mixed or montmorillonitic mineralogy. Very shallow to moderately deep Calciustolls (Talpa, Lueders, Kavett, Tarrant, and Valera series), Ustorthents (Yates series), and Argiustolls (Tarpley and Speck series) are on limestone plateaus or cuestras. Deep Chromusterts (Leeray series) and Haplustolls (Nukrum series) are in valleys at the base of cuesta scarps. Shallow and moderately deep Ustochrepts (Owens and Throck series) are on scarps and shaly uplands.

Shallow to deep Haplustalfs (Callahan series), Rhodustalfs (Exray series), and Paleustalfs (Bonti and Truce series) are on hills and ridges and are underlain by interbedded sandstone and shale. Shallow Calciustolls (Cho and Mereta series) and deep Calciustolls (Nuvalde and Rowena series), Chromusterts (Reap series), and Pellusterts (Roscoe series) are on ancient alluvium and outwash. Paleustolls (Sagerton series), Paleustalfs (Winters and Wichita series), and Haplustalfs (Thurber series) are on outwash and stream terrace deposits. Deep Haplustolls (Elandco, Deleon, Frio, and Gowen series) and Ustifluvents (Bunyan, Yahola, Clairemont, and Lincoln series) are on younger stream deposits on flood plains.

Potential natural vegetation: This area supports savanna vegetation. The potential vegetation is rather uniform throughout the area despite the wide variation in soils. Little bluestem, indiangrass, big bluestem, sideoats grama, hairy grama, and Texas wintergrass are the dominant grass species. Post oak and blackjack oak, sumacs, bumelias, and elm are the dominant woody species. There also are numerous perennial forbs, including Maximilian sunflower, heath aster, bushsunflower, and Engelmann-daisy.

I—SOUTHWEST PLATEAUS AND PLAINS RANGE AND COTTON REGION

175,990 km² (67,950 mi²)

This region is in the warmer part of the southern Great Plains. Moderate precipitation is accompanied by high temperatures, and precipitation effectiveness is low. The average annual precipitation is 500 to 750 mm throughout most of the region, but it ranges from 375 to 900 mm. Generally, much of the precipitation falls in spring and in autumn. The average annual temperature ranges from 16 to 22°C. The freeze-free period ranges from 210 to more than 325 days, increasing in length from north to south. Freeze-free years are common in the extreme southern part of the region.

The major soils on uplands are Argids and Orthids in the west and Ustalfs, Ustolls, and Usterts in the east. Ustolls and Usterts are especially prominent in the southeast. Shallow Orthents are on uplands throughout the region. Soil temperatures generally are higher than 22°C south of the Edwards Plateau. Slopes range from steep to nearly level.

Range is the dominant land use in most of this region, but wheat, grain sorghum, and other small grains are grown in places where soils, topography, and moisture supply are favorable. Cotton grown under irrigation is important in the southeast. Citrus fruits and winter vegetables are grown along the lower Rio Grande Valley area.

81—Edwards Plateau

Texas

96,770 km² (37,370 mi²)

Land use: Most of this area is range. Local tracts are cultivated, and a few are irrigated; the source of water is ground water and streams. The range is grazed by beef cattle, sheep, goats, and wildlife. Hay, pasture, and small grain for grazing are the principal crops. Pecan orchards are on flood plains. Irrigated cotton and grain sorghum are grown locally. Hunting leases for deer, quail, mourning dove, wild turkey, and javelina are an important source of income. The major concern of management is controlling brush that invades the grasslands.

Elevation and topography: Elevation ranges from 200 to 500 m on valley floors. On hills and in plateaus it ranges from 400 to 1,200 m, increasing gradually from east to west. Valleys are narrow to broad and have gently sloping to steep walls and smooth to undulating floors. Hills are sloping to very steep. Plateaus are broad and nearly level to undulating.

Climate: *Average annual precipitation*—375 to 750 mm. About three-fourths of the precipitation falls during the growing season. *Average annual temperature*—18 to 20°C. *Average freeze-free period*—230 to 270 days.

Water: In the western part rainfall is adequate for range grasses but inadequate for cultivated crops, and in the central and eastern parts rainfall is marginal for both. High temperatures and high evaporation and transpiration rates in summer limit crop production. Only a few rivers and streams flow throughout the year. Deep wells provide some water for irrigation and livestock and for domestic needs.

Soils: Most of the soils are Ustolls. They are stony and moderately fine textured and fine textured. These soils have a thermic temperature regime, an ustic

moisture regime, and carbonatic or montmorillonitic mineralogy. Very shallow and shallow, gently sloping to sloping Calciustolls (Ector and Tarrant series) are on limestone hills. Shallow and moderately deep, nearly level to gently sloping Calciustolls (Kavett and Valera series) are on plateaus. Deep, nearly level Chromusterts (Tobosa and Anhalt series) occur on broad limy outwash plains and broad plateaus. Shallow, gently sloping to steep Ustochrepts (Brackett series) are on hills of marl and chalk. Haplustolls (Frio and Rioconcho series) are on the younger stream deposits of valley floors.

Potential natural vegetation: This area supports a plant community ranging from desert shrub vegetation in the west to a mixed oak savanna with tall and mid grasses in the east. Mid and short grasses and an abundance of low-growing woody plants characterize the vegetation in the west. Oaks in association with mid and tall grasses grow in the central and eastern parts. The savanna ranges from nearly open grasslands with scattered trees to oak stands interspersed with grasses. Forbs are in great abundance throughout the Edwards Plateau.

82—Texas Central Basin

Texas

5,500 km² (2,120 mi²)

Land use: Most of this area is range. Small acreages are cultivated, and a few are irrigated from ground water. The range is grazed mainly by beef cattle, sheep, and wildlife. Grain sorghum, cotton, peanuts, and small grain for grazing are the principal crops. In a few places, land formerly used for crops is now used as pasture or is reverting to range. Hunting leases for deer, quail, mourning dove, and wild turkey are an important source of income. Fishing camps and other water-based recreation also contribute to the

economy. The major concern of management is controlling brush that invades the grasslands.

Elevation and topography: Elevation ranges from 200 to 300 m on valley floors, but on hills and plateaus it ranges from 300 to 400 m. The broad valleys have moderately sloping walls and smooth to undulating floors. The hills are moderately sloping to steep, and the plateaus are broad and gently sloping to undulating.

Climate: *Average annual precipitation*—625 to 750 mm. About three-fourths of the precipitation falls during the growing season. *Average annual temperature*—18 to 20°C. *Average freeze-free period*—210 to 270 days.

Water: The rainfall is adequate for range grasses but is marginal for crops because of extended high temperatures and high evaporation and transpiration rates during the summer. Only a few rivers and large streams flow throughout the year, and irrigation from these sources is limited. Deep wells provide water for some irrigation. Shallow and deep wells and ponds provide water for livestock and for domestic needs.

Soils: Most of the soils are Ustalfs. They are somewhat gravelly and moderately coarse textured and have a thermic temperature regime, an ustic moisture regime, and mixed mineralogy. Deep and moderately deep, nearly level to gently sloping Paleustalfs (Pedernales and Castell series) occur on limy outwash and gneiss. Shallow and moderately deep, gently sloping to sloping Haplustalfs (Click and Oben series) occur in areas underlain by granite and sandstone. Ustochrepts (Keese series) are on the steeper slopes underlain by granite, and Ustorthents (Nebgen series) are on the steeper slopes underlain by sandstone. Shallow to moderately deep, undulating Haplustolls (Harper series) and Argiustolls (Rumple series) are on uplands underlain by limestone.

Potential natural vegetation: This area supports a mixed oak savanna vegetation of live oak, post oak, and blackjack oak with tall and mid grasses such as little bluestem, sideoats grama, indiangrass, and switchgrass, sand and plains lovegrass, green sprangletop, purpletop, pinhole bluestem and plains bristlegrass. Such forbs as orange zexmania, bushsunflower, Engelmann-daisy, and trailing ratany grow throughout the area. A mid grass community with scattered individual or groves of live oak and post oak grows on the shallow and more droughty soils. Major grass species on these sites are sideoats grama, meadow dropseed, pinhole bluestem, Arizona cottontop, vine mesquite, Texas wintergrass, and little bluestem.

83A—Northern Rio Grande Plain

Texas

20,900 km² (8,070 mi²)

Land use: Most of the area is range, but large acre-

ages are cultivated. The range is grazed mainly by beef cattle and wildlife. Grain sorghum, cotton, corn, flax, and small grain for grazing are the main crops. Local areas are irrigated. Hunting leases for deer, quail, and mourning dove are an important source of income. The major concern of management is controlling the brush and cactus that invade the grasslands.

Elevation and topography: Elevation ranges from 25 m in the southeast to 200 m in the northwest. These plains are nearly level but smooth hills and valleys are gently rolling. The valleys are narrow to broad. The hills are mostly in the east.

Climate: *Average annual precipitation*—625 to 750 mm. Most of the precipitation falls during the growing season. *Average annual temperature*—21 to 22°C. *Average freeze-free period*—260 to 310 days.

Water: Rainfall is adequate for range grasses but marginal for cultivated crops. High temperatures and high evaporation and transpiration rates limit crop production. The Nueces River and deep wells provide water for irrigation. Deep wells and ponds provide water for livestock and for domestic use.

Soils: Most of the soils are Ustalfs. They are deep and moderately coarse textured and coarse textured. These soils have a hyperthermic temperature regime, an ustic moisture regime, and mixed mineralogy. Ustolls are also extensive. Gently sloping to undulating Paleustalfs (Floresville, Miguel, Webb, and Wilco series) are on plains. Nearly level to gently sloping Argiustolls (Clareville and Elmendorf series) and Calciustolls (Knippa series) are in broad valleys. Gently sloping to rolling Calciustolls (Olmos and Pettus series) are on hills.

Potential natural vegetation: This area supports open grassland with scattered mesquite, live oak, and other trees. Little bluestem, sideoats grama, lovegrass tridens, fourflower trichloris, Arizona cottontop, plains bristlegrass, and other mid grasses are dominant on the deeper soils. A number of forbs, including orange zexmania, catclaw sensitivebrier, western indigo, and bushsunflower grow on these soils. Open grassland with scattered low-growing brush, such as guajillo, blackbrush, elbowbush, and kidneywood, characterize the shallower soils. Arizona cottontop, sideoats grama, green sprangletop, and twoflower trichloris are dominant mid grasses on these soils.

83B—Western Rio Grande Plain

Texas

23,470 km² (9,060 mi²)

Land use: Most of this area is range grazed by beef cattle and wildlife. Grain sorghum, small grain, cotton, and improved pasture are the principal crops. Small grain is mostly grazed for winter pasture. Hunting leases for deer, quail, mourning dove, wild turkey, and javelina are an important source of

income. The major concern of management is controlling brush and cactus that invade the native grasslands. Locally, saline and alkali soils are a land use problem.

Elevation and topography: Elevation ranges from 50 m in the southeast to 300 m in the northwest. Much of this plain is gently undulating and somewhat dissected by intermittent drainageways.

Climate: *Average annual precipitation*—425 to 525 mm. Maximum precipitation is during the growing season. *Average annual temperature*—21 to 22°C. *Average freeze-free period*—260 to 290 days.

Water: Rainfall is adequate for the growth of range grasses. In most years it is inadequate for cropland because of saline soils, high temperatures, and high evaporation and transpiration rates. The Rio Grande is the major perennial stream; other rivers flow intermittently. Locally, deep wells and ponds provide water for livestock, domestic use, and irrigation.

Soils: Most of the soils are Usterts and Torrerts. They are deep, fine textured saline soils that have montmorillonitic mineralogy. Also extensive are Ustolls and Orthids that have been mixed mineralogy. These soils have a hyperthermic temperature regime and an ustic or aridic moisture regime. Nearly level to gently sloping Pellusterts (Montell and Monteola series) are on plains over clayey marine sediments. Gently undulating Torrerts (Catarina series) are on plains in the southwestern part of the area. Nearly level Haplustolls (Dant series) and Calcistolls (Elindio series) are on broad plains in the northern part. Shallow and gravelly Calcistolls (Jimenez and Olmos series) are on ridges and small hills. Nearly level to gently undulating Calciorthids (Copita and Pryor series) are on plains over marine sediments.

Potential natural vegetation: This area supports open grassland with scattered shrubs. Mid grasses such as alkali sacaton, twoflower trichloris, pink pappusgrass, white tridens, whiplash pappusgrass, and vine-mesquite are dominant on deep, clayey soils. Guayacan, spiny hackberry, desert yaupon, and fourwing saltbush are the principal shrubs. Bundleflower, bushsunflower, Texas varilla, and other forbs make up a minor but significant part of the plant communities. The more gravelly soils support semiopen grassland vegetation of mid grasses interspersed with low-growing shrubs. Guajillo, blackbrush, and kidneywood are the principal shrubs. Arizona cottontop, sideoats grama, pink pappusgrass, pinhole bluestem, green sprangletop, and tanglehead are the dominant grasses. Several species of forbs grow on these soils, mainly bushsunflower, orange zexmania, snoutbeans, daleas, and gauras.

83C—Central Rio Grande Plain

Texas

23,470 km² (9,060 mi²)

Land use: Most of this area is range grazed by beef

cattle and wildlife. Grain sorghum, cotton, and small grain for grazing are the main crops. Local areas are irrigated. Hunting leases for deer, wild turkey, quail, mourning dove, javelina, and exotic game animals are an important source of income. The major concern of management is controlling brush and cactus that invade the grasslands.

Elevation and topography: Elevation ranges from 25 m in the east to 200 m in the northwest. This plain is nearly level to gently undulating and is weakly dissected by intermittent drainageways.

Climate: *Average annual precipitation*—525 to 650 mm. Maximum precipitation is during the growing season. *Average annual temperature*—21 to 23°C. *Average freeze-free period*—280 to 325 days.

Water: Rainfall is adequate for the growth of range grasses, but crop yields are limited by periods of moisture stress caused by high temperatures and high evaporation and transpiration rates. Deep wells and ponds provide water for irrigation, livestock, and domestic use.

Soils: Most of the soils are Ustalfs. They are moderately deep to deep and moderately coarse textured and coarse textured and have mixed mineralogy. Ustolls are also extensive. These soils have a hyperthermic temperature regime and an ustic moisture regime. Gently undulating Paleustalfs (Nueces and Sarita series) are on sandy eolian plains. Nearly level to gently sloping Paleustalfs (Delfina and Delmita series) are on loamy eolian plains in the central and eastern parts of the area. Nearly level to gently undulating Haplustalfs (Brennan and Comitas series) are on loamy eolian plains in the central and western parts. Gently sloping to gently undulating Calcistolls (Hidalgo and Olmos series) and Haplustolls (Tordia series) are on plains underlain by ancient marine sediments. Nearly level to gently undulating Orthids (Copita, Randado, and Zapata series) are on plains in the western part of the area.

Potential natural vegetation: This area supports prairie vegetation with a few scattered trees and shrubs. Major species on soils with deep, fine sand surfaces are tall and mid grasses such as seacoast bluestem, indiangrass, crinkleawn, and tanglehead and an abundant variety of perennial legumes and forbs. Species commonly growing on soils on loamy eolian plains in the central and eastern parts of the area are mid grasses such as Arizona cottontop, fourflower thichloris, tanglehead, plains lovegrass, and pinhole bluestem. Many forbs and low-growing shrubs, including condalias, vine ephedra, and guajillo, grow with these grasses.

83D—Lower Rio Grande Valley

Texas

6,600 km² (2,550 mi²)

Land use: Most of this area is cropland or improved pasture that is extensively irrigated, but large acre-

ages are in range. Major crops are cotton, grain sorghum, citrus, onions, cabbage, and other truck crops. The range is mainly grazed by beef cattle and wildlife. Hunting leases for quail, white-winged dove, and mourning dove are an important source of income. Major land use problems are saline soils and inadequate subsurface drainage on cropland.

Elevation and topography: Elevation ranges from sea level in the east to about 200 m in the northwest, but is mainly less than 100 m. Much of the area is nearly level. Drainageways are shallow and have low gradients.

Climate: *Average annual precipitation*—425 to 700 mm. Maximum precipitation is during the growing season. *Average annual temperature*—22 to 23°C. *Average freeze-free period*—300 to 330 days.

Water: Rainfall is adequate for the growth of range grasses. It is low in the western and central parts of the area and marginal in the eastern. High temperatures and high evaporation and transpiration rates limit crop production. The Rio Grande, the only perennial stream, provides water for irrigation. Locally, deep wells and ponds provide water for livestock, domestic use, and irrigation.

Soils: Most of the soils are Ustalfs. They are deep, moderately fine textured and fine textured soils that

formed in alluvial sediments. They have a hyperthermic temperature regime, an ustic moisture regime, and mixed mineralogy. Ustolls having mixed mineralogy are also extensive. Nearly level to gently sloping Paleustalfs (Delfina and Nueces series) are on plains in the northeast. Nearly level to gently undulating Haplustalfs (Brennan, Duval, and Hebbronville series) are on plains in the west. Nearly level to gently sloping Calciustolls (Hidalgo and Raymondville series) are on plains in the central and eastern parts of the area. Nearly level Ustifluvents (Camargo, Rio Grande, and Zalla series) are on flood plains along the Rio Grande.

Potential natural vegetation: This area supports open mid grass prairie vegetation with scattered woody plants and some perennial forbs and legumes on upland soils. Twoflower and fourflower trichloris, plains bristlegrass, and lovegrass tridens are among the dominant grasses. Desert yaupon, spiny hackberry, and blackbrush are major woody plants. Tall and mid grasses such as switchgrass, giant sacaton, fourflower trichloris, big sandbur, little bluestem, and southwestern bristlegrass are dominant on the savanna plant communities on bottom lands. Hackberry and elms are major woody plants. Forbs are important but minor components of the plant communities.

J—SOUTHWESTERN PRAIRIES COTTON AND FORAGE REGION

145,120 km² (56,030 mi²)

This region consists of prairies and savannas in eastern Texas, in south-central Oklahoma, and in southeastern Kansas. The average annual precipitation ranges from 625 to 1,150 mm. The average annual temperature ranges from 15 to 22°C, and the freeze-free period is 190 to 280 days.

Ustalfs, Ustolls, and Usterts are the dominant soils. Ustalfs are on the upland savannas, and Ustolls and Usterts are in the prairies.

The prairies are intensively farmed. Cotton, grain sorghum, wheat, other feed grains, and hay are important crops. The more sloping savannas are used mainly for grazing. Locally, peanuts and watermelons are important crops.

84A—Cross Timbers

Kansas, Oklahoma, and Texas

27,400 km² (10,580 mi²)

Land use: Nearly all this area is in farms and ranches.

About 40 percent is rangeland, 30 percent woodland, 15 percent pastureland, and almost 15 percent cropland. The rest is used for urban development and for other purposes. All the rangeland, woodland, and pastureland is grazed by beef cattle, but locally there are some dairy cattle. Small grains, grain sorghum, cotton, alfalfa, and other hay crops are important in much of the area. Large acreages of peanuts, tree fruits, and vegetables are grown in the south.

Elevation and topography: Elevation ranges from 300 to 400 m, but along the Red River it is 200 m. Ridgetops on these rolling to hilly uplands are nearly level to strongly rolling and narrow to moderately broad. Stream valleys are narrow and have steep gradients. Local relief is mostly a few tens of meters, but the large valleys are 50 m or more below the adjacent uplands.

Climate: *Average annual precipitation*—625 mm in the west to 900 mm in the east. Maximum precipitation is in spring, and the minimum is in winter. Snowfall ranges from 30 cm in the north to 10 cm in the south. *Average annual temperature*—15 to 17°C. *Average freeze-free period*—190 to 240 days.

Water: The moderate and somewhat erratic rainfall is the source of water for range and crops. Large reservoirs provide water for cities and towns and for recreation or flood control. Farm ponds are a major source of water for livestock. In most of the area, shallow wells supply water for domestic use, but ground water is scarce in places where sandstone and shale are near the surface.

Soils: The major soils are Ustalfs and Ochrepts. They have a thermic temperature regime and an ustic moisture regime. The Ustalfs are loamy and have a loamy or clayey subsoil and siliceous or mixed mineralogy. Well drained, very gently sloping, undulating to sloping or hummocky, moderately deep to deep Haplustalfs (Dougherty, Konawa, Stephenville, and

Weatherford series) are on uplands. Well drained and moderately well drained, very gently sloping to steep or rolling, deep Paleustalfs (Chaney, Demona, Duffau, Eufaula, Nimrod, Niotaze, and Windthorst series) are on uplands. Ochrepts are shallow and loamy and have siliceous mineralogy. Well drained to somewhat excessively drained, very gently sloping, shallow Ustochrepts (Darnell series) are on ridge crests and steep valley slopes. Well drained, deep, nearly level Ustifluvents (Bunyan, Pulaski, and Pulexas series) and somewhat poorly drained, nearly level, deep Udifluvents (Tribbey series) are on flood plains.

Potential natural vegetation: This area supports an open stand of trees with an understory of mid and tall grasses, forbs, and low woody plants. Post oak and blackjack oak are the dominant tree species. Big bluestem, little bluestem, indiangrass, sunflower, and lespedezas are the major species in the herbaceous understory.

84B—West Cross Timbers

Oklahoma and Texas

15,050 km² (5,810 mi²)

Land use: Most of this area is in farms and ranches.

About 85 percent is native grass pasture, improved grass pasture, or noncommercial oak forests that are used for grazing. Most of the pastureland, rangeland, and woodland is grazed by beef cattle, but dairy cattle are important in some places. In general, the acreage of cropland is decreasing, and that of improved pasture is increasing. About 14 percent of the area is farmed to peanuts, grain sorghum, small grains, or forage sorghum. Improved bermudagrass and other hay crops are important. Locally, peaches, apples, pecans, and vegetables are important crops. About 1 percent of the area is used for urban development and for other purposes.

Elevation and topography: Elevation is mainly 300 to 400 m, but along the Red River it is about 200 m. These uplands are nearly level to rolling and are moderately dissected. Land in the north has a higher average slope gradient and is gullied. Land in the south is nearly level to undulating and has been

affected more by soil blowing. Stream valleys are narrow and have steep gradients. Local relief is mostly several meters.

Climate: *Average annual precipitation*—625 to 875 mm, decreasing east to west. Maximum precipitation is in spring and in fall. Average precipitation during the frost-free period is about 500 to 600 mm. The summer moisture deficit ranges from about 175 to 250 mm. *Average annual temperature*—17 to 19°C. *Average freeze-free period*—225 to 240 days.

Water: The moderate and somewhat erratic rainfall is the source of water for pasture and crops. Shallow wells for supplemental irrigation are common in the south, but the availability and quantity of water varies greatly. Farm ponds are a major source of water for livestock. Local streams have intermittent flow. A few large reservoirs provide water for cities and towns and for recreation and irrigation. In most of the area, shallow wells supply water for domestic use, but ground water is scarce in places where sandstone and shale are near the surface.

Soils: Most of the soils are Ustalfs. They are well drained and moderately well drained, medium textured and coarse textured. These soils have a thermic temperature regime, an ustic moisture regime, and mixed or siliceous mineralogy. Deep, nearly level to undulating Paleustalfs (Windthorst, Duffau, Eufaula, and Konsil series) and nearly level to undulating, deep to moderately deep Haplustalfs (Chaney, Demona, Nimrod, Patilo, and Pedernales series) and deep, nearly level to undulating Haplustalfs (Cisco series) occur on uplands in the south. Ustifluvents (Bunyan, Energy, and Pulexas series) and Haplustolls (Elandco and Lamkin series) are on the narrow flood plains.

Potential natural vegetation: This area supports savanna vegetation. Tall grass is interspersed with trees and underbrush. Little bluestem, purpletop tridens, indiangrass, switchgrass, big bluestem, sand lovegrass, post oak, blackjack oak, elm, coralberry, greenbrier, and elbowbush are dominant species. Engelmann-daisy, Maximilian sunflower, and trailing wildbean are among the numerous perennial forbs.

84C—East Cross Timbers

Texas

5,790 km² (2,240 mi²)

Land use: Most of this area is in farms and ranches, but sizable acreages in the central section are rapidly being converted to urban uses. About 80 percent of the rural land is in improved pasture, native grass pasture, or noncommercial oak forest vegetation and is grazed by beef cattle. About 10 percent of the area is farmed to peanuts, small grain, forage sorghums, and fruit and vegetable crops. In general, the acreage of cropland is decreasing, and that of improved pasture and urban development is increasing.

Elevation and topography: Elevation is about 200 m. Extensive gently sloping to rolling uplands are moderately dissected. Sloping to rolling sandstone-capped hills and ridges rise prominently above the surrounding uplands. Stream valleys are narrow and have steep gradients. Local relief is mostly from 1 to 10 or 15 m.

Climate: *Average annual precipitation*—875 to 1,000 mm. Maximum precipitation is in spring and in fall. Average precipitation during the frost-free period is about 600 to 650 mm. The summer moisture deficit ranges from about 125 to 200 mm. *Average annual temperature*—17 to 19°C. *Average freeze-free period*—227 to 250 days.

Water: The moderate and somewhat erratic rainfall is the major source of water for pasture and crops. Large reservoirs provide water for cities and towns and for recreation. Farm ponds are a major source of water for livestock. In most of the area, shallow wells supply water for domestic use. A few small irrigation wells supply a very limited quantity of water. Local streams have intermittent flow.

Soils: Most of the soils are Ustalfs. They are well drained and medium textured and coarse textured. These soils have a thermic temperature regime, an ustic moisture regime, and mixed, siliceous, or montmorillonitic mineralogy. Shallow to moderately deep Haplustalfs (Rayex series) and Paleustalfs (Birome series) are on sandstone-capped hills and ridges. Moderately deep to deep, gently sloping to sloping Paleustalfs (Aubrey, Birome, Callisburg, Crosstell, Gasil, and Konsil series) are on uplands. Deep, gently sloping Paleustalfs (Silstid and Heaton series) and Quartzipsamments (Arenosa series) are on sandy uplands. Haplustolls (Gowen series) and Ustifluvents (Pulexas and Bunyan series) occupy narrow flood plains.

Potential natural vegetation: This area supports oak savanna vegetation with a tall grass understory. Little bluestem, purpletop tridens, indiangrass, switchgrass, big bluestem, post oak, blackjack oak, elm, coralberry, American beautyberry, bumelia, greenbrier, and elbowbush are some of the dominant species. Engelmann-daisy, lespedezas, and trailing wildbeans are among the numerous perennial forbs.

85—Grand Prairie

Oklahoma and Texas

31,650 km² (12,220 mi²)

Land use: Most of this area is in farms and ranches, but urbanization is increasing in the central and southern parts. More than 40 percent is native rangeland, and about 15 percent is improved pasture. Beef cattle are the principal livestock, but dairy cattle and sheep are important in the central and southern parts. About 25 percent of the area, including valleys, bottom lands, and the deeper soils on

uplands, is cropland. Oats, wheat, grain sorghum, forage sorghum, cotton, corn, and hay are the principal crops. Native pecan orchards are common along the flood plains. Deer and wild turkey hunting leases are an important source of income in the south.

Elevation and topography: Elevation is 200 to 400 m but ranges from 400 to 500 m on some of the high peaks in the southwest and in the Arbuckle Mountains in the north. The area consists of a gently rolling to hilly, dissected limestone plateau and of the low, rugged Arbuckle Mountains. Stream valleys are shallow and narrow in their upper reaches but deepen and broaden near the eastern edge of the area. Steep slopes border the valleys of larger streams and are along the side slopes of flat-topped plateaus and in most of the Arbuckle Mountains. Relief is mainly several meters, but the large valleys are about 50 m below the adjacent uplands.

Climate: *Average annual precipitation*—700 to 1,025 mm. Maximum precipitation is in spring and in fall. More than half of the precipitation falls during the frost-free period. *Average annual temperature*—17 to 21°C. *Average freeze-free period*—200 to 260 days.

Water: The moderate but somewhat erratic rainfall is the source of water for crops, pasture, and range. The large rivers flow all year. Several large lakes and flood-detention reservoirs are potential sources of water for irrigation but are little used for this purpose now. Deep ground water is abundant, and many springs and wells are throughout the area.

Soils: Most of the soils are Ustolls, Usterts, and Ochrepts. They are well drained and moderately well drained and moderately fine textured and fine textured. They have a thermic temperature regime, an ustic moisture regime, and montmorillonitic, mixed, or carbonatic mineralogy. Moderately deep to deep, nearly level to gently sloping Pellusterts (San Saba, Branyon, and Slidell series) and Chromusterts (Crawford and Sanger series) are on uplands, in upland valleys, and on ancient stream terraces. Shallow to moderately deep, gently sloping Calciustolls (Purves, Bolar, and Denton series) are on the smooth uplands. Very shallow to shallow, gently rolling to hilly, mostly stony or gravelly Haplustolls (Aledo and Eckrant series), Calciustolls (Tarrant, Purves, and Doss series), and Argiustolls (Speck and Tarpley series) are on limestone ridges and plateaus. Shallow, gravelly, or stony Ustochrepts (Brackett series) and Calciustolls (Real series) are on the steeper side slopes of the plateaus. Deep, well drained Haplustolls (Krum series), Argiustolls (Blanket series) and Calciustolls (Venus and Lewisville series) are on outwash in the valleys and along stream terraces. Deep, well drained Haplustolls (Frio, Bosque, and Gowen series) are on flood plains. Deep Argiustolls (Durant series), Paleudolls (Newtonia series), and Haplustalfs (Normangee series) are on smooth up-

lands in the north. Shallow, stony Haplustolls (Kiti series) and areas of rock outcrop occur on the Arbuckle Mountains in the north.

Potential natural vegetation: This area supports prairie vegetation with widely scattered live oak trees. Little bluestem, indiangrass, big bluestem, and switchgrass are typical species. Little bluestem, sideoats grama, tall grama, and scattered shrub live oak and juniper trees characterize the natural vegetation on the very shallow soils and along escarpments.

86—Texas Blackland Prairie

Texas

47,860 km² (18,480 mi²)

Land use: Nearly all this area is in farms, but urban development is increasing. About 40 percent of the area is cropland, about 45 percent improved pasture or rangeland, and the remainder urban areas or narrow strips of woodland along streams. Cotton and grain sorghum are the major cash crops. Other principal crops are small grain, corn, soybeans, and johnsongrass and other hay crops. Wheat and soybeans are important local crops in the north, and corn is an important crop in the south. Native pecan orchards are common along the flood plains. The present trend is toward a decrease in cropland on the more sloping and eroded soils and an increase in pasture. Beef cattle are the principal livestock.

Elevation and topography: Elevation ranges from 100 to 200 m, increasing gradually from south to north and from east to west. The area is mostly a nearly level to gently rolling dissected plain. Nearly level to gently sloping uplands merge into narrow valleys that have more sloping valley walls. Large rivers that cross the area have broad but shallow valleys. Significant tracts of hilly land are along the Austin chalk escarpment near the western side of the area. Relief is mainly from 1 to 10 m.

Climate: *Average annual precipitation*—750 to 1,150 mm. Maximum precipitation is in spring and in fall. Average precipitation during the frost-free period is about 600 to 650 mm. *Average annual temperature*—17 to 21°C. *Average freeze-free period*—230 to 280 days.

Water: In most years the moderate rainfall is adequate for crops and pastures, but summer droughts that reduce crop yields are common. The large rivers flow all years. Many large lakes and small flood-detention reservoirs provide municipal water supplies and recreation facilities and help to control flooding. Small farm ponds on individual farms are an important source of water for livestock. Ground water is scarce throughout the area, but in a few places small quantities of water are obtained from wells.

Soils: Most of the soils are Usterts, Ustolls, Aqualfs, and Ustalfs. They are well drained to somewhat

poorly drained and medium textured to fine textured. These soils have a thermic temperature regime, an ustic or aquic moisture regime, and montmorillonitic, mixed, or carbonatic mineralogy. Moderately deep to deep, nearly level to gently sloping Pellusterts (Houston Black, Branyon, Dalco, Leson, and Burleson series) are on uplands, in valleys, and on stream terraces. Moderately deep to deep, gently sloping to sloping Chromusterts (Heiden, Ferris, and Vertel series) are on eroded uplands. Shallow to moderately deep, gently sloping to moderately steep Haplustolls (Austin and Stephen series) and very shallow, gently sloping to moderately steep Ustorthents (Eddy series) are on uplands along the Austin chalk escarpment. Deep, nearly level to gently sloping Calciustolls (Lewisville and Venus series) and Haplustolls (Krum series) are in valleys and on stream terraces. Deep, nearly level to sloping Albaqualfs (Mabank series), Ochraqualfs (Wilson series), and Paleustalfs (Crockett series) are on uplands. Somewhat poorly drained Pelluderts (Trinity and Kaufman series), Haplaquolls (Tinn series), and moderately well drained Chromusterts (Ovan series) are on flood plains.

Potential natural vegetation: This area supports true prairie vegetation in which little bluestem is dominant. Indiangrass, big bluestem, switchgrass, and eastern gamagrass are major species. Many forbs grow in the area. Along major rivers and tributaries, the plant community is a savanna. Oak, elm, cottonwood, hackberry, and pecan produce a 30-percent canopy. Sedges, Virginia and Canada wildrye, rustysed paspalum, beaked panicum, switchgrass, indiangrass, little and big bluestem, eastern gamagrass, and vine-mesquite are major herbaceous species. Tickclover, trailing wildbean, lespedezas, and gayfeather are common forbs.

87—Texas Claypan Area

Texas

13,510 km² (5,210 mi²)

Land use: Most of this MRLA is in farms. Urban use is inextensive but is expanding in a few places. Most of the farmland is used for pasture and range; some of the pasture was formerly cropped. About half is in improved grasses that are fertilized. Much of the rangeland has been overgrazed. The remaining acreage is in native and annual grasses. The cropland is used principally for grain sorghum, but cotton, corn, peanuts, hay, and truck crops are important in some places. About a third of the farmland is in woodlots.

Elevation and topography: Elevation ranges from 50 to 200 m. The Claypan Area is a nearly level to sloping plain. Dissected sites are steeper along entrenched river and creek valleys. Valleys of large streams are shallow, and the wide flood plains are bordered by nearly level terraces.

Climate: *Average annual precipitation*—750 to 1,075 mm. Maximum precipitation is in winter and in spring, and the minimum is in summer and in autumn. *Average annual temperature*—18 to 22°C, increasing from north to south. *Average freeze-free period*—240 to 280 days.

Water: The moderate precipitation is the major source of water for crops and pasture. Rainfall in summer is erratic, and in most years crop yields are reduced by a lack of moisture. A few large reservoirs on major streams provide municipal water and also serve as recreation facilities. Water for farm use comes from ponds and wells.

Soils: Most of the soils are Ustalfs. They are deep, medium textured and moderately coarse textured soils that have a slowly or very slowly permeable clayey subsoil. They have a thermic temperature regime, an ustic moisture regime, and montmorillonitic mineralogy. Moderately well drained, nearly level and gently sloping Paleustalfs (Axtell and Tabor series) and poorly drained Albaqualfs (Arol, Falba, and Lufkin series) are on the uplands. Interspersed in many places are well drained and moderately well drained Paleustalfs (Tremona, Catilla, Straber, Patilo, Padina, and Silstid series) that have a thick sandy surface. Pelluderts (Kaufman and Trinity series), Pellusterts (Burleson series), Haplustolls (Ships series), and Hapludolls (Pledger series) are on flood plains and clayey terraces along the Trinity and Brazos Rivers.

Potential natural vegetation: The climax plant community in this area is oak savanna. Little bluestem is dominant on all sites except those that are poorly drained. Little bluestem and beaked panicum are dominant in poorly drained areas. Indiangrass, brownseed paspalum, beaked panicum, switchgrass, and big bluestem grow throughout the area. The area also supports a wide variety of forbs, legumes, shrubs, and woody vines such as dayflower, spiderwort, bundleflower, lespedezas, sensitivebrier, hackberry, hawthorn, yaupon, elbowbush, greenbrier, and honeysuckle. Some mixed pine-hardwood forests are in the southwest and in the east. Hardwood forests of oak, elm, pecan, and other species grow on the wet bottom lands.

K—NORTHERN LAKE STATES FOREST AND FORAGE REGION

277,100 km² (106,990 mi²)

Soils poorly suited to cultivation and a short cool growing season severely limit agriculture in this region. The average annual precipitation ranges from 500 to 825 mm. Maximum rainfall occurs during the growing season. The average annual temperature is 2 to 7°C, and the freeze-free period ranges from 95 to 145 days.

The more or less freely drained Boralfs are the dominant soils. Aqualfs and Aquepts are on wet uplands and in depressions. Psamments and Orthods (mainly in the northeast) are on sand plains. Histosols are in wet low areas and in bogs.

A large part of this region is forested, and lumbering and recreation are the principal uses. Mining is a major industry in all parts of the region except in the east. Forage and some grains grown for dairy cattle and other livestock are the main crops in the farmed areas. Locally, potatoes and vegetables for canning are important crops.

57—Northern Minnesota Gray Drift

Minnesota

21,440 km² (8,280 mi²)

Land use: About 50 percent of this area is in farms, and most of the remainder is in timber. A large part of the timber is in a national forest. There are many lakes, and water-based recreation is a significant enterprise. The farms usually are small and are used mainly for growing forage and feed grain for livestock. Sunflowers, wheat, and other cash crops are grown on some farms, mainly in the western part of the area.

Elevation and topography: Elevation ranges from 300 to 500 m. The rolling glacial moraine and associated outwash has short, choppy, and complex slopes. Relief varies as much as 25 to 50 m within a short distance. Lakes are common.

Climate: *Average annual precipitation*—525 to 675 mm. About 350 to 450 mm of precipitation falls during the growing season. *Snowfall* ranges from 100 to 125 cm. *Average annual temperature*—3 to 6°C. *Average freeze-free period*—100 to 120 days.

Water: The abundant supply of surface and ground water meets all present needs of the area. Many lakes provide ample opportunity for recreation.

Soils: Most of the soils are Boralfs. Aqualfs and Fibrists are in wet places and in depressions. The soils are deep and medium textured and have a frigid temperature regime and mixed mineralogy. Well drained and moderately well drained, nearly level to sloping Eutroboralfs (Nebish, Waukon, and Warba series) are on uplands. Ochraqualfs (Shooker series) are on level sites. Borofibrists (Brophy series) and Sphagnofibrists (Waskish series) formed in organic materials in depressions.

Potential natural vegetation: This area supports forest vegetation. Aspen, northern hardwoods, white spruce, blackberry, blue cohosh, and false-Solomons-seal grow on the finer textured soils. Bur oak, red pine, jack pine, wintergreen, roses, and big bluestem grow on the sandy soils.

88—Northern Minnesota Glacial Lake Basins

Minnesota

31,010 km² (11,970 mi²)

Land use: More than 80 percent of this area is forested and is used mainly for lumbering and recreation. The remainder is used for growing feed grains and forage for beef and dairy cattle. Some grass and legume seed are produced as a cash crop. An adverse climate and poorly drained soils severely limit use of the land for agriculture.

Elevation and topography: Elevation ranges from 300 to 400 m. This area is nearly level. At one time it was occupied by broad glacial lakes.

Climate: *Average annual precipitation*—500 to 675 mm. About 350 to 450 mm fall during the growing season. In most years, *snowfall* ranges from 102 to 127 cm. *Average annual temperature*—3 to 5°C. *Average freeze-free period*—95 to 105 days.

Water: Ample water supplies meet the present needs of the area. There are a few large lakes and major streams.

Soils: Most of the soils are Aqualfs, Boralfs, Sapristis, and Fibrists. The mineral soils are deep and medium textured to fine textured and have a frigid temperature regime and mixed mineralogy. Well drained and moderately well drained, level and gently sloping Eutroboralfs (Baudette and Taylor series) and poorly drained Ochraqualfs (Indus and Spooner series) are in lacustrine materials. Borosapristis (Rondeau and Cathro series) and Sphagnofibrists (Wasish series) formed in organic residues in the wetter depressional parts of the area.

Potential natural vegetation: This area supports swamp and forest vegetation. Black spruce and varying mixtures of tamarack, northern white-cedar, and black ash are in conifer swamps. Low shrubs, mosses, and herbaceous plants such as *Labradortea ledum*, leatherleaf, creeping snowberry, marshmarigold, sedges, and sphagnum mosses are in bog swamps. The mineral soils support species such as quaking aspen,

balsam fir, northern hardwoods, mountain maple, glossy buckthorn, skunk currant, and sweet white violet.

90—Central Wisconsin and Minnesota Thin Loess and Till

Minnesota and Wisconsin
55,750 km² (21,530 mi²)

Land use: Except for the state and national forests and some Indian reservations, nearly all this area is in farms. Slightly more than one-fourth is cropland used mainly for growing feed grains and forage for dairy cattle. Potatoes, sweet corn, and canning peas are important cash crops. Other vegetables and fruits are grown locally. About one-sixth of the area is pasture and native grasses. Most of the remainder is forested, mainly farm woodlots and state and national forests. Forested areas are used for pulp and timber production and for recreation. Controlling erosion on steep slopes and improving drainage on wet soils are the principal concerns of management.

Elevation and topography: Elevation ranges from 300 to 500 m. Locally, the level to rolling till plains are mantled by loess. The topography is irregular; there are nearly level outwash plains and lacustrine basins, low hills and ridges, and many lakes and organic deposits in basins. Local relief is mainly a few meters, but some hills rise more than 50 m above the adjacent lowlands.

Climate: *Average annual precipitation*—625 to 750 mm. Most of the precipitation falls during the growing season. Winter precipitation is mainly snow. *Average annual temperature*—4 to 7°C. *Average freeze-free period*—120 to 140 days.

Water: The moderate precipitation generally is adequate for crops and pasture, but in dry years crops on sandy soils are damaged by a lack of moisture. Most of the wet lowland soils need to be drained for good crop and forage production. Ground water is abundant in deep glacial drift deposits but scarce in areas where the drift is thin. The many lakes and streams are also sources of water.

Soils: Most of the soils are Boralfs. They are moderately deep to deep and medium textured and have a frigid temperature regime and mixed mineralogy. Well drained and moderately well drained, nearly level to moderately sloping Glossoboralfs (Santiago, Otterholt, Spencer, and Antigo series), somewhat poorly drained, nearly level to moderately sloping Glossaqualfs (Almena and Withee series), and nearly level to moderately sloping Ochraqualfs (Freer series) in loess-mantled drift are on outwash and till plains. Ochraqualfs (Marshfield series), Glossaqualfs (Auburndale series), Haplaquepts (Cable and Rib series) and Haplaquolls (Adolph series) are the lower lying wet mineral soils. Borosapristis (Seeleyville and Lupton series) and Borohemists (Rifle and Green-

wood series) in the deeper depressions formed in organic residue from plants. Udipsamments (Plainfield, Menahga, and Friendship series) are on the sandy outwash plains. Udifluvents are on the flood plains of rivers and streams.

Potential natural vegetation: This area supports natural stands of mixed northern hardwood forest vegetation on the medium textured soils. Oak, maple, white ash, elm, and basswood are dominant species. Natural stands of jack, red, and white pine grow on the sandy soils. Pioneer species of aspen, paper birch, and cherry are on the uplands; spruce and larch are in the depressions. Growing in some parts of the west are prairie vegetation characterized by little and big bluestem and scattered oak trees.

91—Wisconsin and Minnesota Sandy Outwash

Minnesota and Wisconsin
52,780 km² (20,380 mi²)

Land use: About 90 percent of this area is in farms. About 10 percent, mostly in Wisconsin, is state and federally owned. Nearly one-third of the area is cropland. Feed grains and forage for livestock are the main crops, but truck crops are also important. Potatoes and canning crops such as snap beans, peas, and corn are commonly grown under irrigation. Cranberries are grown on some wet soils. About one-tenth of the area is forested and used mainly for pulp and timber production. These forested areas and associated lakes and streams provide recreation facilities. Controlling soil blowing and conserving moisture on sandy soils, improving drainage on wet soils, and maintaining soil fertility are major concerns of management.

Elevation and topography: Elevation is about 300 m. Topography ranges from uniformly level areas in some places to irregular nearly level and gently rolling areas. In Minnesota many lakes are in basins and depressions. Local relief throughout the area is mostly from 1 to 10 m.

Climate: *Average annual precipitation*—About 625 mm in Minnesota and 750 to 825 mm in Wisconsin. Most of the precipitation falls during the growing season. Precipitation in winter is snow. *Average annual temperature*—4 to 7°C. *Average freeze-free period*—125 to 145 days.

Water: In years of normal precipitation, the moderate precipitation is inadequate for crops and pasture on sandy soils. In years of little or no precipitation, crop yields are seriously reduced. Irrigation is widely used for high-value crops. The wet lowland soils need to be drained for good crop production. Ground water is abundant in the glacial deposits.

Soils: Most of the soils are Psamments. They are deep and coarse textured and have mesic and frigid temperature regimes and mixed mineralogy. Well drained

and moderately well drained, nearly level and rolling Udipsamments (Plainfield, Coloma, Brems, Menahga, and Zimmerman series) and somewhat poorly drained, nearly level and rolling Udipsamments (Morocco and Meehan series) are on sandy outwash plains or on sandy till uplands. Humaquepts (Newton series) and Haplaquolls (Isanti series) are underlain by sandy drift on wet lowlands. Borosaprists (Seeleyville and Lupton series) and Borochemists (Rifle and Greenwood series) in deeper depressions formed in organic residue from plants. Nearly level and gently rolling Argiudolls (Dakota series), Hapludolls (Dickman, Burkhardt, Sparta, and Dickinson series), and Hapludalfs (Tell, Meridian, and Wyocena series) formed on outwash and till uplands that have a loamy covering over the sandy drift. Udifluvents are on flood plains of rivers and streams.

Potential natural vegetation: This area supports oak-pine forest vegetation. Mixed forest stands of pin oak and jack pine grow on coarse textured upland soils. Big and little bluestem and scattered trees are in prairie openings. Loamy upland soils support oak-hickory forest vegetation. Sedge meadows, spruce and larch, and aspen and jack pine grow on low wetlands.

92—Superior Lake Plain

Michigan, Minnesota, and Wisconsin

4,950 km² (1,910 mi²)

Land use: More than three-fourths of this area is forested, nearly all of which is privately owned and used for timber production and for recreation. Between 5 and 10 percent is cropland. Feed grains and hay for dairy cattle and other livestock are the principal crops. Locally, potatoes and small fruit are important cash crops. Only 1 or 2 percent of the land is pasture.

Elevation and topography: Elevation ranges from 200 to 300 m, increasing gradually from the lakeshore inland. Some rocky knobs, hills, and low mountains make up part of this nearly level lake plain. Local relief on the lake plain is only a meter or two, but the adjoining hills and mountains rise sharply 25 m to more than 100 m above the plains.

Climate: *Average annual precipitation*—625 to 875 mm. Maximum precipitation is in midsummer and the lowest in midwinter. Precipitation in winter is snow. *Average annual temperature*—3 to 6°C. *Average freeze-free period*—Less than 100 days to 140 days, decreasing from the lakeshore inland.

Water: Precipitation is adequate for crops and pasture. Level areas of wet soils need to be drained for good growth of crops. There are few inland lakes, but much of the area has access to Lake Superior for recreation.

Soils: The dominant soils are Boralfs and Orthods. They are deep and moderately deep and fine textured

to moderately coarse textured. These soils have a frigid temperature regime and mixed or illitic mineralogy. Well drained to somewhat poorly drained Eutroboralfs (Ontonagon, Rudyard, and Watton series) formed in clayey and loamy lacustrine sediments and glacial till. Well drained Haplorthods (Michagamme series) formed in glacial drift over bedrock, and Fragiorthods (Gogebic, Iron River, and Munising series) formed in loamy glacial till. Associated soils are Haplaquepts (Pickford series) and Haplaquods (Tula series).

Potential natural vegetation: This area supports forest vegetation of broadleaf deciduous and needleleaf evergreen trees. Sugar maple, yellow birch, American beech, and hemlock are the dominant tree species. White spruce, balsam fir, paper birch, and red maple commonly grow on the wetter soils.

93—Superior Stony and Rocky Loamy Plains and Hills

Michigan, Minnesota, and Wisconsin

56,080 km² (21,650 mi²)

Land use: More than four-fifths of this area is forested, about half of which is privately owned, and half consists of county, state, or national forests. Lumbering, mining, and recreation are important. Only about 10 percent of the area is cropland or pasture. Feed grains and forage for dairy cattle and other livestock are the main crops. In places potatoes are an important cash crop. Cranberries are grown on wet soils in some parts of Wisconsin. Some soils are too stony or too rocky to be used for crops. A short growing season, improving drainage on wet soils, and maintaining fertility are the principal concerns of management.

Elevation and topography: Elevation ranges from 300 to 600 m, but on a narrow strip bordering the Great Lakes it is about 200 m. These undulating to rolling glacial drift plains are bordered on the north by high hills. Local relief is mainly a few meters to several tens of meters. In many places the hills rise 100 or 200 m above the adjacent lowlands. Many small lakes and some large lakes are in this area.

Climate: *Average annual precipitation*—750 mm. About two-thirds of the precipitation falls during the growing season. Precipitation in winter is snow. *Average annual temperature*—2 to 6°C. *Average freeze-free period*—80 to 140 days, decreasing with increasing elevation and from the Great Lakes inland.

Water: The moderate precipitation generally is adequate for crops and pasture, but in years of little or no precipitation, crops on sandy soils are damaged by a lack of moisture. Most of the soils on wet lowlands need to be drained for good crop and forage production. Ground water is abundant in deep glacial deposits but scarce in areas where the drift is thin. The lakes and streams are additional sources of water.

Soils: Most of the soils are Orthods. They are moderately deep to deep, somewhat stony, and medium textured. These soils have a frigid temperature regime, an udic moisture regime, and mixed mineralogy. Moderately well drained and well drained Fragiorthods, which have a fragipan, (Munising, Gogebic, Wakefield, and Iron River series) and Haplorthods (Goodman and Stambaugh series) are on outwash plains and uplands. Nearly level Haplaquepts (Cable series) are on lowlands. Borosaprists (Seelyeville, Loxley, and Carbondale series) and Borochemists (Rifle, Greenwood, and Spalding series) are in deeper depressions. They formed in plant residue. Sandy Haplorthods (Vilas, Kalkasa, and Rubicon series) formed in sandy drift scattered throughout the area. Areas of stony land and rock land are on some of the steeper slopes, knobs, and hills.

Potential natural vegetation: The upland soils in this area support natural stands of mixed northern hardwood and pine forest vegetation. Sugar maple, yellow birch, hemlock, white pine, and red pine are the dominant species. The lowland areas support natural stands of spruce and larch forest vegetation or sphagnum moss bogs. Aspen, paper birch, and cherry are pioneer species on the upland soils.

94A—Northern Michigan and Wisconsin Sandy Drift

Michigan, Minnesota, and Wisconsin
39,920 km² (15,410 mi²)

Land use: About a third of this MLRA consists of national and state forests; another third is in small privately owned holdings. There are a few large holdings. The forests are used mainly for lumbering and recreation. Forage and feed grains for dairy cattle and other livestock are the principal crops. In places potatoes are an important cash crop, and other vegetables and fruit are also grown. Cranberries are grown on lowland soils in Wisconsin.

Elevation and topography: Elevation ranges from 200 m along the lakeshores to more than 500 m in the central part. Belts of morainic hills make up part of this broad glacial-drift plain. Much of the area is nearly level to gently rolling, and local relief is only a few meters, but in the morainic areas local relief ranges from several meters to more than 100 m.

Climate: *Average annual precipitation*—675 to 850 mm. Precipitation is fairly evenly distributed in late spring through early autumn. Minimum precipitation is in winter; winter precipitation is mainly snow. *Average annual temperature*—4 to 7°C. *Average freeze-free period*—120 to 140 days along the lakeshores, but in some low areas it is as short as 80 days.

Water: Because of the moderate precipitation, moisture must be carefully managed to insure that enough water is available for crops and pasture grown on the sandy soils. The wet soils on lowlands must be

drained before they can be used for field crops and tame pasture commonly grown in the area. Ground water is abundant in the deep glacial drift that covers nearly all the area. Many large and small lakes are used extensively for recreation.

Soils: Most of the soils are Orthods or Saprists. They have a frigid temperature regime, and the mineral soils have mixed mineralogy. Deep, coarse textured, and moderately coarse textured Haplorthods (Kalkaska, Vilas, Rubicon, Emmett, and Montcalm series) formed in sandy or loamy glacial drift. The associated very poorly drained Borosaprists (Carbondale, Lupton, and Tawas series) formed in organic materials in depressions. Also important in the area are Udi-psamments (Grayling and Omega series) on outwash plains, Psammaquents (Roscommon series) and Haplaquods (Au Gres and Kinross series) in flat, wet areas, and Eutroboralfs (Nester, Kawkawlin, and Rudyard series) and Haplaquepts (Pickford and Sims series) on moraines, till plains, and lake plains.

Potential natural vegetation: This area supports forest vegetation of broadleaf deciduous and needleleaf evergreen trees. Jack pine, red pine, and bigtooth aspen are the dominant tree species on the more sandy soils. Sugar maple, yellow birch, American beech, and hemlock are dominant on the moist sites. Tamarack, black spruce, and northern white-cedar are dominant on the wet soils.

94B—Michigan Eastern Upper Peninsula Sandy Drift

Michigan
15,170 km² (5,860 mi²)

Land use: About 5 percent of this MLRA is cropland; most of the rest is forested. More than half of the forest land is in national and state forests. Most of the remaining forest land is in small holdings, but there are a few large holdings. The forests are used mainly for lumbering and recreation. Forage and feed grains for dairy cattle and other livestock are the principal crops.

Elevation and topography: Elevation ranges from 200 to 300 m, increasing gradually from the shores of the Great Lakes inland. This broad glacial-drift plain consists of some broad swampy areas. Much of this area is nearly level to gently rolling, and local relief is only one or two meters.

Climate: *Average annual precipitation*—725 to 850 mm. Precipitation is fairly evenly distributed from late spring through early autumn. Minimum precipitation is in winter; precipitation in winter is mainly snow. *Average annual temperature*—4 to 6°C. *Average freeze-free period*—90 to 155 days.

Water: Because of the moderate precipitation, moisture must be carefully managed to insure that enough water is available for crops and pasture grasses grown on the sandy soils. The wet soils on lowlands

must be drained before they can be used for field crops and tame pasture grasses commonly grown in the area. Ground water is abundant in the deep glacial drift.

Soils: Most of the soils are Orthods, Sapristis, or Hemists. They have a frigid temperature regime, and the mineral soils have mixed mineralogy. Deep, coarse textured and moderately coarse textured, well drained and moderately well drained Haplorthods (Kalkaska, Rubicon, Emmet, Onaway, and Longrie series) and Fragiorthods (Trenary series) formed in sandy or loamy glacial drift. The associated very poorly drained Borosapristis (Carbondale, Lupton, and Tawas series) and Borohemists (Greenwood and Rifle series) formed in organic materials in depressions. Also important in the area are Eutroboralfs

(Rudyard and Ontonagon series) and Haplaquepts (Pickford and Munuscong series) on moraines, till plains, and lake plains and Psammaquepts (Roscommon series) and Haplaquods (Au Gres series) on flat, wet sites. Locally Eutrochrepts (Detour series) and Haploborolls (Johnswood series) are important on till plains and glacial lake benches.

Potential natural vegetation: This area supports forests of broadleaf deciduous and needleleaf evergreen trees. Sugar maple, paper birch, balsam fir, hemlock, yellow birch, and American beech are the dominant tree species. Jack pine, red pine, and white pine are major species on the more sandy soils. Black spruce, northern white-cedar, and tamarack are dominant on the wetter soils.

L—LAKE STATES FRUIT, TRUCK, AND DAIRY REGION

193,780 km² (74,820 mi²)

The soils and climate in this region are favorable for agriculture. Typically, the land surface is a nearly level to gently sloping glaciated plain. The average annual precipitation ranges from 675 to 925 mm, but it is 1,150 mm in the extreme eastern part. Precipitation is fairly evenly distributed throughout the year. In most of the region, the average annual temperature is 6 to 11°C. The freeze-free season generally is 130 to 180 days, but it is as long as 200 days in narrow belts adjacent to the Great Lakes.

The dominant well drained soils in this region are Udalfs in the southern part and Boralfs in the northern part. Aqualfs and Aquepts are the dominant wet soils throughout the region. The sandy soils are Psamments and Orthods. Histosols are in low wet areas and in bogs.

This region has a wide variety of agricultural enterprises. Dairy farming is important. Canning crops, corn, soft winter wheat, beans, and sugar beets are among the leading crops. Fruits, especially sour cherries, are important in a narrow belt adjacent to the Great Lakes. Much of the cropland near the larger cities is being subdivided and developed for urban uses.

95A—Northeastern Wisconsin Drift Plain

Michigan and Wisconsin
15,760 km² (6,090 mi²)

Land use: More than 90 percent of this MLRA is in farms, nearly 60 percent of which is cropland. Feed grains and hay are the chief crops. Much of the grain is fed to dairy cattle and other livestock on the farms where it grows. Canning crops, fruits, and specialty crops are important. The rest of the land in farms is about equally divided between tame pasture and farm woodlots. Less than 5 percent of the MLRA is used for urban development. Recreation is an important land use, especially along the major streams and on sites bordering Green Bay and Lake Michigan. Controlling erosion on the steeper slopes and improving drainage on wet soils are primary concerns of management.

Elevation and topography: Elevation ranges from 200 to 400 m. Locally, the nearly level to rolling till plains are mantled by silt. Nearly level outwash plains and lacustrine basins, low hills, and ridges are throughout the area. Some lakes and bogs are in basins. Local relief is mainly several meters, but some hills rise more than 50 m above the adjacent lowlands.

Climate: *Average annual precipitation*—700 to 750 mm. About two-thirds of the precipitation falls during the growing season. Winter precipitation is mainly snow. *Average annual temperature*—6 to 8°C. *Average freeze-free period*—120 to 160 days; the longest period is in the south and in a narrow belt along Lake Michigan.

Water: The moderate precipitation generally is adequate for crops and pasture, but in years of little or no precipitation, crops on sandy soils are damaged by a lack of moisture. Most of the wet soils on lowlands

need to be drained for good crop and forage production. Ground water is plentiful in deep glacial drift deposits except in areas where the drift is clayey. Lakes and streams are additional sources of water.

Soils: Most of the soils are Udalfs. They are moderately deep to deep and medium textured and fine textured. These soils have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Well drained and moderately well drained, nearly level to sloping Hapludalfs (Kewaunee, Hortonville, and Theresa series) and Argiudolls (Hochheim series) and somewhat poorly drained, nearly level to sloping Hapludalfs (Manawa and Symco series) are on till plains. In the north, moderately deep to deep, medium textured and moderately coarse textured Orthods, which have a frigid temperature regime and mixed mineralogy, are dominant. Well drained and moderately well drained, gently undulating to sloping Haplorthods (Onaway, Emmet, and Longrie series) and Eutroboralfs (Underhill series) and somewhat poorly drained, gently undulating to sloping Eutroboralfs (Solona series) are on till plains. Haplaquepts (Angelica and Ensley series) in loamy drift and Haplaquolls (Poygan series) in clayey and silty drift are on the lower lying wet mineral sites. Borosaprists (Seeleyville, Lupton, Cathro, and Carbondale series) and Borochemists (Rifle series) that formed in organic residue from plants are in the deeper depressions.

Potential natural vegetation: The upland soils in this area support natural stands of mixed northern hardwoods and pine forest vegetation. Sugar maple, oak, white ash, elm, yellow birch, white and red pine, and American beech are the principal species. Lowland areas support both mixed hardwood and conifer forest vegetation. Elm, soft maple, black ash, and northern white-cedar are major species.

95B—Southern Wisconsin and Northern Illinois Drift Plain

Illinois and Wisconsin
28,530 km² (11,020 mi²)

Land use: More than 90 percent of this MLRA is in farms, 65 percent of which is cropland. Feed grains and forage for livestock are the chief crops. Much of the feed grain and forage is fed to dairy cattle and other livestock on the farms where they are grown, but cash-grain farming is also important. Canning crops, potatoes, fruits, and other specialty crops are important, especially around urban centers. The rest of the land in farms is about equally divided between tame pasture and farm woodlots. Urban areas, mostly in the south and east, make up the rest of the MLRA. Recreation is becoming important. Some of the better farmland is increasingly used for urban development. Controlling erosion on slopes and improving drainage on wet soils are the major concerns of management.

Elevation and topography: Elevation ranges from 200 to 300 m. This area consists of a glaciated plain with belts of morainic hills and ridges and nearly level outwash terraces. Drumlins (long steep-sided oval hills) are a prominent feature in the north-central part. Local relief is mainly a few meters, but the moraines, drumlins, and bedrock escarpments rise 25 to 100 m above the adjacent lowlands.

Climate: *Average annual precipitation*—750 to 825 mm. About two-thirds of the precipitation falls during the growing season. Precipitation in winter is mainly snow. *Average annual temperature*—7 to 9°C. *Average freeze-free period*—140 to 170 days, decreasing from south to north and from Lake Michigan shore inland.

Water: The moderate precipitation generally is adequate for crops and pasture, but in years of little or no precipitation, some crops on coarse textured soils are damaged by a lack of moisture. Many of the fine textured soils need water management practices that facilitate tillage and harvesting operations. Poorly drained soils must be drained for good production of cultivated crops. Ground water is abundant in the underlying drift; sandy and gravelly drift yields the largest amount. Sandstone and limestone bedrock formations below the glacial drift are good sources of water. Lake Michigan and the many inland lakes and streams are additional sources of water for domestic use and for recreation.

Soils: Most of the soils are Udalfs. They are moderately deep to deep and medium textured. These soils have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Moderately well drained and well drained Hapludalfs (Miami, McHenry, Fox Ozaukee, and Theresa series) formed in loamy glacial drift, commonly with a thin silt mantle, on nearly level to sloping relief. Moderately deep, medium

textured Argiudolls (Parr, Plano, Saybrook, Ringwood, and Hochheim series) are associated soils on the same landforms. Haplaquolls (Will and Pella series) and Argiaquolls (Brookston, Westland, Sebewa, and Mussey series) formed in medium textured material on the lowlands. Udipsamments (Plainfield, Oakville, and Chelsea series) are on some of the sandy sites. Udifluvents (Junear and Arenzville series) and Hapludolls (Radford series) are in silty sediments on flood plains.

Potential natural vegetation: This area supports hardwood forest and prairie vegetation. The upland soils support natural stands of oak, sugar maple, and hickory forests and natural prairie characterized by little and big bluestem. Scattered oak and hickory trees grow in many of the prairies. Lowland areas support sedge and grass meadows and mixed stands of hardwood and conifer forests. Elm, ash, cottonwood, soft maple, and white cedar are the major species in the lowland forests.

96—Western Michigan and Northeastern Wisconsin Fruit Belt

Michigan and Wisconsin
10,650 km² (4,110 mi²)

Land use: In Michigan about 60 percent of the area is forested, mainly farm woodlots; about 25 percent is cropland; and 10 percent or more consists of state and national forests and parks. In Wisconsin about 30 percent of the area is forested. Most of the remainder is cropland, and about 10 percent is native and tame pasture. Forage and feed grains for dairy cattle are the major crops, but fruits and specialty crops are also grown and are of great economic importance. This is one of the major areas of production of cherries in the United States. Recreation is an important land use, especially on sites bordering Lake Michigan and Green Bay. Controlling soil blowing and water erosion, conserving moisture, and improving drainage on wet soils are the principal concerns of management.

Elevation and topography: Elevation ranges from 200 to 300 m. This area consists mostly of rolling to hilly moraines and beach ridges, but there are some nearly level plains and bedrock-controlled ridges. Local relief is mainly several meters, but in places, hills rise more than 50 m above the adjacent lowlands. Much of the area rises sharply from the lakeshore to the adjoining hilltops.

Climate: *Average annual precipitation*—675 to 750 mm. Most of the precipitation falls during the growing season. Precipitation in winter is snow. *Average annual temperature*—6 to 8°C. *Average freeze-free period*—135 to 170 days, increasing from north to south and decreasing from the lakeshore inward.

Water: In years of normal precipitation, moisture is adequate for crops, but in years of little or no

precipitation, yields are reduced because of a lack of moisture, especially on the sandy soils and in areas where bedrock is at a shallow depth. Ground water is abundant in the deep sandy and loamy drift areas. Fissures in the limestone bedrock in Wisconsin are also a good source of water. Lake Michigan, Green Bay, and numerous inland lakes are an additional source of water.

Soils: Most of the soils are Orthods or Boralfs. They are moderately deep to deep and medium textured to coarse textured. These soils have a frigid temperature regime, an udic moisture regime, and mixed mineralogy. Well drained Haplorthods (Montcalm, Kalkaska, Rubicon, Emmet, Onaway, and Longrie series) in loamy or sandy textured glacial drift are dominant. Well drained Eutroborthods (Kolberg series) in thin loamy glacial drift over lime rock are important in Wisconsin. In Michigan, well drained and moderately well drained Eutroborthods (Nester series) and somewhat poorly drained Eutroborthods (Kawkawlin series) formed in deep glacial drift. Udipsamments (Grayling series) formed in deep sands. Haplaquepts (Ensley and Ruse series), Haplaquods (Kinross and Au Gres series), and Psammaquents (Roscommon series) formed in sandy and loamy materials in low-lying areas. Borosapristis (Carbondale, Lupton, Cathro, and Seelyeville series) formed from organic remains of plants in the deeper depressions.

Potential natural vegetation: This area supports forest vegetation consisting of broadleaf deciduous and needleleaf evergreen trees. Sugar maple, yellow birch, beech, and hemlock are the dominant tree species. Jack pine, red pine, and white pine are dominant on the more sandy soils. Lowland soils support both mixed hardwood and conifer forests. Elm, soft maple, black ash, and white cedar are the major lowland species.

97—Southwestern Michigan Fruit and Truck Belt

Michigan
5,960 km² (2,300 mi²)

Land use: Nearly four-fifths of this MLRA is in farms, slightly more than half of which is cropland. Fruits, especially peaches and grapes, are grown extensively near the Lake Michigan shore. Many other fruits, vegetables, and melons are also grown. Forage and feed grains for dairy cattle and other livestock are important crops. Some land is in permanent pasture, but most of the farmland that is not cultivated is in woodlots. A large part of the area that is not in farms is in state forests and parks, and about 5 percent is used for urban development.

Elevation and topography: Elevation is about 200 m, but some hills are 300 m. This area consists of a nearly level glacial-drift plain and scattered, gently to strongly rolling morainic hills. Local relief is only a

few meters in most places, but in the rolling areas local relief is 25 to 50 m.

Climate: *Average annual precipitation*—825 to 925 mm. Precipitation is fairly evenly distributed throughout the year, but it is slightly greater late in spring and early in summer and is lower in midwinter. Precipitation in winter is snow. *Average annual temperature*—9 to 10°C. *Average freeze-free period*—160 to 180 days, decreasing from west to east.

Water: In years of normal precipitation, moisture is adequate for crops, but in years of little or no precipitation, yields are reduced by a lack of moisture. Most of the fine textured soils need artificial drainage to insure that tillage operations are not delayed in spring and in fall. Wet areas must be drained for good growth of crops. The deep glacial deposits yield an abundance of ground water for domestic, municipal, and industrial uses. The many small lakes in this area are used extensively for boating, fishing, and other recreation.

Soils: Most of the soils are Udalfs. They are deep, moderately coarse textured and coarse textured. These soils have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Well drained Hapludalfs (Oshtemo and Spinks series) that formed in loamy or sandy glacial drift are dominant. Associated soils are Udipsamments in deep sand (Oakville series) and Ochraqualfs (Blount series) and Hapludalfs (Miami and Morley series) in loamy glacial till. Medisapristis (Houghton series) are in depressions throughout the area.

Potential natural vegetation: This area supports broadleaf deciduous forest vegetation. Bitternut hickory, shagbark hickory, white oak, red oak, black oak, American beech, and sugar maple are the dominant tree species. White ash, red maple, quaking aspen, and black cherry are extensive on the wet sites.

98—Southern Michigan and Northern Indiana Drift Plain

Illinois, Indiana, and Michigan
60,050 km² (23,190 mi²)

Land use: About three-fourths of this MLRA is in farms; much of the remainder is used for urban development, and a small acreage is in state forests and parks. More than one-half of the area is cropped. Corn, other feed grains, and hay for dairy cattle and other livestock are the major crops. Soft winter wheat and dry beans are important cash crops, and fruits and vegetables are grown in many places where the soils and markets are favorable. Less than 10 percent of the area is permanent pasture, and most of the rest of the farmland is in small woodlots.

Elevation and topography: Elevation ranges from 200 to 300 m, but some hills are more than 300 m. This broad glaciated plain is deeply mantled by till and outwash. Much of the area is nearly level to

gently rolling, and local relief is a few meters. Belts of morainic hills, however, have stronger slopes, and relief is as much as 25 to 50 m or more.

Climate: *Average annual precipitation*—750 to 925 mm. Precipitation is fairly evenly distributed throughout the year, but it is slightly higher late in spring and early in summer. *Average annual temperature* —8 to 9°C. *Average freeze-free period*—mainly 140 to 150 days but is 160 days in the southwest.

Water: In much of the area, the moderate precipitation is adequate for crops, but conserving moisture in the coarse textured soils is a major concern of management. Ground water is abundant in the deep glacial drift. Many small and medium-size lakes and many perennial streams are additional sources of water. The lakes are used extensively for recreation.

Soils: Most of the soils are Udalfs or Aqualfs. They are deep, medium textured and moderately coarse textured. These soils have a mesic temperature regime, an udic or aquic moisture regime, and mixed mineralogy. In the south, well drained Hapludalfs (Miami, Hillsdale, Riddles, Fox, and Oshtemo series) and somewhat poorly drained Ochraqualfs (Conover series) that formed in loamy glacial drift are dominant. Associated soils are Argiaquolls (Brookston series) and Haplaquolls (Colwood, Gilford, Maumee, and Granby series) on flats; rolling, excessively drained to moderately well drained Udipsamments (Plainfield and Oakville series); and nearly level and gently sloping, moderately well drained and somewhat poorly drained Udipsamments (Brems and Morocco series). In the south, well drained and moderately drained Hapludalfs (Marlette and Perrington series), somewhat poorly drained Hapludalfs (Ithaca series), and poorly drained Ochraqualfs (Capac series) in loamy glacial till are dominant. Associated soils are Haplaquepts (Parkhill series) and Psammaquents (Kingsville series). Medisapristis (Houghton, Palms, Adrian, and Edwards series) are in depressions throughout the area. Haplorhods are of local importance in the northwest.

Potential natural vegetation: This area supports broadleaf deciduous forests. Bitternut hickory, shagbark hickory, white oak, red oak, black oak, sugar maple, and beech are the dominant tree species. Red maple, white oak, and American basswood are extensive on the wetter soils.

99—Erie-Huron Lake Plain

Indiana, Ohio, and Michigan
35,780 km² (13,810 mi²)

Land use: Nearly nine-tenths of this MLRA is in farms, about two-thirds of which is cropland. Cash crops are important. Corn, winter wheat, soybeans, and hay are the major crops, but sugar beets and canning crops also are important. Some fruit and truck crops are grown on the coarse textured soils. Dairying is an

important enterprise on some farms near the larger cities. The remaining farmland is used for permanent pasture and for other purposes, but most of it is in small farm woodlots. About 10 percent of the area is used for urban development.

Elevation and topography: Elevation is about 200 m, increasing gradually from the lakeshore inland. Local relief on most of this nearly level broad lake plain is only a few meters, but some beach ridges and low moraines rise several meters above the general level.

Climate: *Average annual precipitation*—700 to 875 mm. Precipitation is fairly evenly distributed throughout the year, but it is slightly higher late in spring and early in summer. *Average annual temperature* —7 to 11°C. *Average freeze-free period*—140 to 160 days.

Water: In most years the moderate precipitation provides enough water for crops. Many of the soils require artificial drainage before they can be used for crops, and even the better drained soils need some drainage to insure that tillage operations are not delayed in spring and in fall. The abundant ground water meets domestic and municipal needs in much of the area. The Great Lakes supply water for large cities, are major transportation arteries, and are used for recreation.

Soils: Most of the soils are Aqualfs or Aquepts. They are deep and fine textured to coarse textured. These soils have a mesic temperature regime, an aquic moisture regime, and mixed or illitic mineralogy. The dominant soils are somewhat poorly drained to very poorly drained Ochraqualfs (Nappanee and Hoytville series) and poorly drained and very poorly drained Haplaquepts (Lenawee and Toledo series) that formed in lacustrine and glacial drift. Associated soils are Haplaquolls (Belleville, Colwood, Granby, and Wauseon series), Udipsamments (Tedrow series), and Hapludalfs (Kibbie, Selfridge, and Metea series). Somewhat poorly drained Ochraqualfs (Shebeon series) and poorly drained Haplaquepts (Kilmanagh series), along with associated Haplaquolls (Tappan series) and some Haplaquods (Wixom and Arkona series), are in the “thumb” area of Michigan.

Potential natural vegetation: This area supports broadleaf deciduous forests. Bitternut hickory, shagbark hickory, white oak, red oak, and black oak are dominant. Red maple, white ash, American basswood, and quaking aspen are dominant on the wetter soils.

100—Erie Fruit and Truck Area

New York, Ohio, and Pennsylvania
4,260 km² (1,640 mi²)

Land use: Slightly more than two-thirds of this MLRA is in farms, about a third of which is cropland and the rest about equally divided between pasture and

woodland. Small areas, however, are used for rural residences and for other purposes. The cropland is used for vineyards, orchards, small fruits, canning crops, and truck crops. Dairying is an important enterprise, especially near the larger cities. A large part of the area not in farms is used for urban development, major highways, and railroads. Parks occupy a sizable acreage.

Elevation and topography: Elevation is about 220 m, increasing gradually from the lakeshore inland. This nearly level to gently sloping plain is underlain mainly by lacustrine sediments and partly by glacial till. Low beach ridges are a prominent feature. Local relief is mainly a few meters, but in some places along the lakeshore there are steep wave-cut cliffs.

Climate: *Average annual precipitation*—750 to 900 mm. Precipitation is evenly distributed throughout the year. Heavy snowfall is common in winter. *Average annual temperature*—10 to 11°C. *Average freeze-free period*—Mainly 160 to 180 days, but it is 200 days in a narrow belt in Ohio.

Water: In most years precipitation is adequate for crops except for those on the coarse textured soils. Supplemental irrigation water for high-value fruit and vegetable crops is obtained from wells or from the Great Lakes. The wetter soils must be drained before they can be used for crops, and even the better drained soils benefit from drainage. The abundant ground water meets domestic, industrial, and municipal needs in much of the area, but some of the larger cities obtain water from the Great Lakes. The Great Lakes also provide transportation and are used extensively for recreation.

Soils: Most of the soils are Aquepts and Aqualfs. They are medium textured to fine textured and have a mesic temperature regime, an aquic moisture regime, and illitic mineralogy. Very poorly drained, nearly level Haplaquepts (Conneaut and Allis series) formed in a mantle of lake-deposited silty material, and the underlying medium textured glacial till. Somewhat poorly drained, nearly level to gently sloping Fragiaquepts (Wallington series) formed in stratified, lake-laid loamy material. Poorly drained, nearly level to gently sloping Ochraqualfs (Mahoning series) formed in moderately fine textured glacial till. Well drained, moderately well drained, and somewhat poorly drained, nearly level to moderately steep Hapludalfs (Kibbie, Sisson, and Tuscola series) formed in stratified, lake-laid deposits that generally have a silty and sandy texture.

Potential natural vegetation: This area supports mixed oak, mixed mesophytic, and beech forests. The mixed oak forests consist of white oak, black oak, northern red oak, and some scarlet oak, shagbark hickory, bitternut hickory, pignut hickory, and mockernut hickory. Broadleaf and other deciduous species occur in the mesophytic forest in equal proportions.

Among the dominant species in the beech forests are American beech, sugar maple, red oak, white ash, and white oak. Other dominant species are American basswood, shagbark hickory, black cherry, and, more rarely, cucumbertree.

101—Ontario Plain and Finger Lakes Region

New York

32,790 km² (12,660 mi²)

Land use: Most of this area is in farms. About one-half of the acreage is cropland used mainly for hay, corn, and small grains associated with dairy operations. Cash crops, including canning and truck crops, wheat, and dry beans, are also produced. Orchard crops are important locally, particularly near Lake Ontario. Vineyards are common near some of the Finger Lakes. About one-third of the area is forested, mostly in farm woodlots. Urban uses account for about 14 percent of the area and are expanding around the larger cities, such as Buffalo, Rochester, and Syracuse.

Elevation and topography: Elevation is 100 to 400 m, increasing gradually from the shores of the Ontario and Oneida Lakes to the Allegheny Plateau, the southern border of the area. Most of the area is a nearly level to rolling plain. Low remnant beach ridges are commonly interspersed with a relatively level lake plain in the north. Drumlins (long, narrow, steep-sided, cigar-shaped hills) are prominent in an east-west belt in the center of the area. The Finger Lakes area consists of a gently sloping to rolling till plain. Local relief is mostly a few meters, but the larger drumlins and many valley sides rise 25 to 100 m above the adjacent lowlands or valley floors. Streams generally flow northward, but the Mohawk River flows eastward.

Climate: *Average annual precipitation*—900 to 1,150 mm, increasing from west to east. Precipitation is evenly distributed throughout the year. Snowfall is heavy in winter. *Average annual temperature*—7 to 10°C. *Average freeze-free period*—Mainly 140 to 160 days, but it is 180 days in a narrow belt along Lake Ontario.

Water: In most years the moderate precipitation is adequate for crops, but in years of little or no precipitation yields are reduced by a lack of moisture. The Finger Lakes, Lake Ontario, streams, farm ponds, and wells are potential sources of irrigation water for high-value crops. Ground water is abundant in most areas. It is close to the surface throughout much of the year in the lowlands, which extend across the northern part of the area. Lake Ontario and many of the larger lakes provide opportunities for recreation. The New York State Barge Canal, traversing the area from east to west, is an important transportation artery.

Soils: Most of the soils are Udalfs. They are deep,

medium textured and moderately fine textured. These soils have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Well drained and moderately well drained, undulating to moderately sloping Hapludalfs formed in high lime glacial till (Honeoye, Cazenovia, and Hilton series) and lacustrine sediments (Collamer, Schoharie, and Galen series). Nearly level to gently sloping, somewhat poorly drained Ochraqualfs (Appleton and Niagara series) are extensive in low areas. Poorly drained and very poorly drained Haplaquepts (Canadaigua and Lamson series) formed in lacustrine sediments and are common at the lowest elevations in the northern part of the area. Hapludalfs (Palmyra and Wampsville series) formed in calcareous outwash deposits, and

moderately deep tills (Aurora and Lairdsville series) are prominent locally but are of small extent. Well drained and moderately well drained Eutrochrepts (Hamlin and Teel series) formed in alluvial deposits along streams.

Potential natural vegetation: This area supports forest vegetation, particularly hardwoods. The potential forest types are elm-ash-red maple or beech-birch-sugar maple in varying proportions. Other species associated with these types include basswood, hemlock, white pine, black cherry and some species of upland oak. Northern whitecedar, red maple, black ash, and aspen grow on the wet soils. Cattails and mosses grow on the organic soils and on other extremely wet sites.

M—CENTRAL FEED GRAINS AND LIVESTOCK REGION

725,500 km² (280,110 mi²)

Fertile soils and a favorable climate make this one of the outstanding grain-producing regions of the world. The average annual precipitation is 625 to 900 mm in much of the region but ranges from 500 mm in the extreme northwest to 1,150 mm along the eastern and southern fringe. Somewhat more than half the precipitation falls during the growing season. The average annual temperature ranges from 6 to 13°C. The freeze-free period is 140 to 180 days in most of the region, but it is as short as 130 days along the northern fringe and as long as 235 days in the extreme southwest.

Udolls and Udalfs are the dominant well drained soils, and Aqualfs and Aquolls are the dominant wet soils. Some of the Udalfs and Aqualfs in the eastern part of the region have a fragipan. Fluvents are along streams, and Orthents are on strongly sloping sites.

Corn, soybeans, oats, and other feed grains are the chief crops. Hay, winter wheat, and many other crops are also grown. Much of the grain is fed to beef cattle and hogs on the farms where it is grown. A large amount, however, is shipped to other regions for livestock feed, exported to foreign countries, or processed for food and industrial uses.

102A—Rolling Till Prairie

Minnesota and South Dakota

38,600 km² (14,900 mi²)

Land use: Most of this area is in farms, and about 70 percent is cropland. The area is used primarily for crops grown for sale or for feeding livestock. Corn, soybeans, alfalfa, flax, spring wheat, and oats are the principal crops. Wooded sections generally are narrow bands along streams and rivers or are shelterbelts around farmsteads. Recreation is an important land use around the many natural lakes in the northern part of the area.

Elevation and topography: Elevation ranges from 300 to 400 m on lowlands to 400 to 500 m on uplands. Isolated highs on the Prairie Coteau in northern South Dakota are about 600 m. The nearly level to rolling topography has many depressions and ill-defined drainages. Steeper slopes are on the sides of drainageways and in breaks adjacent to some of the larger tributaries.

Climate: *Average annual precipitation*—500 to 600 mm. Half or more of the precipitation falls during the growing season. Precipitation in winter is mostly snow. *Average annual temperature*—6 to 9°C. *Average freeze-free period*—120 to 140 days.

Water: Precipitation is the principal source of moisture for crops. In many years it is inadequate for maximum production. Shallow wells in glacial deposits and small ponds are the principal sources of water for livestock. Many natural lakes are in the north, and many of the larger ones are used for recreation.

Soils: Most of the soils are Borolls. They are deep and loamy and silty and have a frigid temperature regime and mixed mineralogy. The nearly level to rolling Haploborolls (Aastad, Barnes, Buse, Kranzburg, and Svea series) and Argiborolls (Forman and Peever series) are on till uplands. Poorly drained Argiaquolls

(Parnell series) and Haplaquolls (Quam series) are in upland depressions.

Potential natural vegetation: This area supports true prairie vegetation characterized by big and little bluestem, porcupinegrass, and green needlegrass. Needleandthread and prairie dropseed are important species on the steeper soils. Prairie cordgrass commonly grows in wet areas.

102B—Loess Uplands and Till Plains

Iowa, Minnesota, South Dakota, and Nebraska

43,790 km² (16,910 mi²)

Land use: Most of this area is in farms, and about 70 percent is cropland. The area is used primarily for crops grown for sale or for feeding livestock. Corn, soybeans, grain sorghum, alfalfa, and oats are the principal crops. Wooded sections generally are narrow bands along streams and rivers or are shelterbelts around farmsteads. Irrigation is increasingly practiced in areas where water supplies are available. Urban development is expanding around some of the larger cities.

Elevation and topography: Elevation ranges from 300 to 400 m on the Missouri River bottom land to 400 to 500 m on uplands. The loess uplands are characterized by long smooth slopes and well-defined drainages. The till plains are mostly nearly level to gently rolling and have many depressions and ill-defined drainages. Steeper slopes are on the sides of drainageways and in breaks adjacent to some of the larger tributaries.

Climate: *Average annual precipitation*—500 to 650 mm. Half or more of the precipitation falls during the growing season. Precipitation in winter is mainly snow that averages about 62 to 102 cm. *Average annual temperature*—9 to 11°C. *Average freeze-free period*—135 to 165 days.

Water: Precipitation is the principal source of moisture for crops, but in some years it is inadequate for maximum production. Shallow wells are the principal source of water for domestic and livestock needs. Water for irrigation is available along some of the major rivers and the larger tributaries.

Soils: Most of the soils are Ustolls. They are deep and silty and loamy and have a mesic temperature regime, an ustic moisture regime, and mixed mineralogy. Well drained, nearly level to moderately sloping Haplustolls (Belfore, Moody, and Nora series) are on loess uplands, and Ustorthents (Crofton series) are on the steeper parts of the landscape. Other well drained, nearly level to moderately sloping Haplustolls (Clarno, Egan, Ethan, and Wentworth series) are on sites in the till plains, and Ustorthents (Betts series) are on the steeper slopes. Poorly drained Argialbolls (Tetonka series), Argiaquolls (Worthing series), and Haplaquolls (Whitewood series) are in upland depressions. Fluvaquents (Albaton series), Haplaquolls (Lamo and Luton series), and Udifluvents (Haynie series) are dominant on the stream valley floors and bottom land of the Missouri River.

Potential natural vegetation: This area supports true prairie vegetation characterized by big and little bluestem, indiagrass, porcupinegrass, and green needlegrass. Needleandthread and prairie dropseed are important species on the steeper soils. Prairie cordgrass usually grows in the wet areas.

103—Central Iowa and Minnesota Till Prairies

Iowa and Minnesota
71,990 km² (27,800 mi²)

Land use: Nearly all this area is in farms, and about three-fourths is cropland. The proportion of cropland is highest in the southern part of the area. Corn, soybeans, and other feed grains are major crops. Some cropland is used for hay. Dairy farming is an important enterprise in the north. Between 10 and 15 percent of the area is permanent pasture. Narrow bands of woodland on steep slopes border stream valleys, and some of the wet bottom land is also forested. About 5 percent of the area is used for urban development, and a similar proportion is used for other purposes.

Elevation and topography: Elevation ranges from 300 to 400 m. Most of this area is a nearly level to gently rolling till plain, but some morainic hills are in the east. Relief is mainly a few meters, but some major valleys are 50 m or more below the adjoining uplands.

Climate: *Average annual precipitation*—625 to 850 mm. Two-thirds or more of the precipitation falls during the freeze-free period. *Average annual temperature*—6 to 9°C, decreasing to 4°C in the

northwest. *Average freeze-free period*—130 to 160 days.

Water: The moderate precipitation is adequate for crops, but in years of low rainfall yields are reduced. Ground-water supplies are adequate for domestic, livestock, and municipal needs. Some natural lakes and ponds and a few artificial reservoirs provide water and recreation.

Soils: Most of the soils are Udolls, Udalfs, Aqualfs, and Aquolls. They are deep and medium textured and moderately fine textured and have a mesic temperature regime and mixed mineralogy. Well drained and moderately well drained, nearly level to sloping Hapludolls (Clarion and Nicollet series) and Hapludalfs (Kelkenny, Lester, and Le Sueur series) are on uplands. Poorly drained Haplaquolls (Webster, Marna, Madelia, and Canisteo series) and Ochraqualfs (Lerdal series) are on level and slightly depressed surfaces.

Potential natural vegetation: This area supports natural prairie vegetation characterized by little bluestem, indiagrass, and switchgrass. Little bluestem, indiagrass, and needlegrass grow on sandy, droughty soils. Little bluestem, sideoats grama, blue grama, and scattered trees and shrubs of bur oak, juniper, and sumac grow on very shallow soils.

104—Eastern Iowa and Minnesota Till Prairies

Iowa and Minnesota
22,640 km² (8,740 mi²)

Land use: Nearly all this area is in farms, and about 80 percent is cropland. Corn, soybeans, other feed grains, and hay are the major crops. Less than 10 percent is pasture. A similar proportion is wooded, mainly on wet bottom land and on steep slopes bordering stream valleys. Raising and feeding hogs and beef cattle and dairying are important enterprises. Many of the wet soils require artificial drainage for good growth of field crops commonly grown in the area. Erosion is a hazard on sloping soils.

Elevation and topography: Elevation ranges from 300 to 400 m. This nearly level to gently sloping till plain mainly has local relief of a few meters. The streams have narrow and shallow valleys in their upper reaches, and only in the east is there much dissection.

Climate: *Average annual precipitation*—700 to 850 mm. More than two-thirds of the precipitation falls during the growing season. Precipitation in winter is mainly snow. *Average annual temperature*—6 to 9°C. *Average freeze-free period*—140 to 160 days.

Water: Precipitation is generally adequate for crops, but in years of little or no precipitation yields are reduced. Ground water is adequate for livestock, domestic, and municipal needs.

Soils: Most of the soils are Udolls, Udalfs, and Aquolls.

They are deep and medium textured and moderately fine textured and have a mesic temperature regime and mixed mineralogy. Moderately well drained and well drained, gently sloping Hapludolls (Kenyon and Ostrander series), Argiudolls (Dinsdale series), and Hapludalfs (Racine and Renova series) are on uplands. Somewhat poorly drained, nearly level or gently sloping Hapludolls (Floyd and Klinger series) and poorly drained, nearly level or gently sloping Haplaquolls (Clyde series) are in concave areas on the uplands. Well drained Hapludolls (Waukegan series) and poorly drained Haplaquolls (Marshan series) are on stream terraces. Moderately well drained Hapludolls (Spillville series) and Haplaquolls (Coland series) are on bottom lands.

Potential natural vegetation: This area supports prairie vegetation. Big bluestem and indiangrass are dominant on the well drained soils on the rolling slopes. Switchgrass, prairie cordgrass, and prairie dropseed are better adapted to the somewhat poorly drained soils. Switchgrass, sedges, and rushes grow in poorly drained draws or valleys. Common cattails grow on swampy sites. Little bluestem, porcupinegrass, and sand lovegrass grow on sandy, rocky, dry sites. Forbs such as clovers, phlox, sunflower, gayfeather, and goldenrod grow on the better soils. Roundhead lespedeza, spiderwort, and flowering spurge grow on the droughty soils. Loosestrife, bedstraw, milkweed, and tickclovers are water-tolerant species that grew on wet soils.

105—Northern Mississippi Valley Loess Hills

Illinois, Iowa, Wisconsin, and Minnesota.
57,520 km² (22,210 mi²)

Land use: Nearly all this area is in farms, but only about two-fifths is cropland. Feed grains and forage for dairy cattle and other livestock are the principal crops. About one-fifth of the area is permanent pasture. Nearly one-third, mainly the more sloping parts, consists of farm woodlots used for commercial timber production and for farm products. The Mississippi River and major tributaries provide opportunities for recreation. Controlling erosion on sloping lands and protecting lowlands from stream overflow are the principal concerns of management.

Elevation and topography: Elevation ranges from 200 m on the valley floors to 400 m on the highest ridges. The sloping to hilly uplands are dissected by both large and small tributaries of the Mississippi River. Bottom land along all streams is narrow. Some ridgetops are broad and have undulating slopes. Local relief is mainly several meters to several tens of meters.

Climate: *Average annual precipitation*—750 to 900 mm. Two-thirds or more of the precipitation falls

during the freeze-free period. *Average annual temperature*—7 to 10°C. *Average freeze-free period*—140 to 160 days.

Water: In most years the moderate precipitation is adequate for crops and forage, but in years of little or no precipitation, yields on thin soils over bedrock are reduced. Ground water is abundant in outwash deposits in the valleys, but the amount varies on the uplands. The supply of ground water in areas underlain by sandstone and limestone generally is moderate. The many springs, streams, and farm ponds are additional sources of water.

Soils: Most of the soils are Udalfs. They are moderately deep and deep and medium textured. These soils have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Well drained Hapludalfs (Fayette, Dubuque, Seaton, Gale, Nordness, and Norden series) that formed in a loess mantle over bedrock or in glacial till are dominant. Nearly level to gently sloping Argiudolls (Tama, Dodgeville, Richwood, and Dakota series) and Hapludolls (Muscatine series) are on benches and broad ridgetops. Hapludolls (Frontenac, Brodale, and Bellechester series) are on steep slopes bordering the major valleys. Well drained Udifluvents (Dorchester, Chaseburg, and Arenzville series) are along stream bottoms. Quartzipsamments (Boone series) are on steep slopes, and nearly level Udipsamments (Plainfield and Gotham series) are on stream benches. Steep, stony, and rocky soils are also common in the area.

Potential natural vegetation: The upland soils support natural hardwood forest vegetation. Oak, hickory, and sugar maple are the dominant species. Big and little bluestem and scattered oak trees grow on some sites. The lowland soils support mixed hardwood forest vegetation. Elm, cottonwood, river birch, ash, silver maple, and willow are the dominant species. Sedge and grass meadows and scattered trees grow on some lowland sites.

106—Nebraska and Kansas Loess-Drift Hills

Kansas and Nebraska
27,090 km² (10,460 mi²)

Land use: Nearly all this area is in farms, and between one-half and three-fourths is cropland. Wheat and corn are important cash crops, but a large acreage of grain sorghum, soybeans, and alfalfa and other hay crops are grown. Most of the grain and hay is fed to livestock on the farms where they are grown. About one-fourth of the area is pasture or range. Cropland is more extensive on the less sloping soils that formed in loess. Pastures of native grasses are more extensive on strongly sloping to steep soils that formed in glacial till. Pastures of introduced grasses and legumes are on the better soils, but native grasses are

common on the more sloping shallow soils. Native woodland is confined to narrow bands bordering drainageways and streams and on some nearly level, wet soils on bottom lands.

Elevation and topography: Elevation ranges from 300 to 500 m, increasing from east to west. In most places this dissected glacial-drift plain is mantled by thick loess. Ridgetops are broad and smooth, and slopes are nearly level to strongly sloping. Stream valleys are bordered by relatively narrow bands of hilly to steep slopes. Valley floors are narrow except along one or two of the larger tributaries of the Missouri River. Local relief is mainly several meters, but some of the larger valleys are 25 to 50 m or more below the level of the adjacent uplands.

Climate: *Average annual precipitation*—750 to 925 mm, increasing from northwest to southeast. About three-fourths of the precipitation falls from late in spring through early autumn. The scant precipitation in winter is mainly snow. *Average annual temperature*—About 13°C. *Average freeze-free period*—160 to 190 days.

Water: Precipitation is generally adequate for crops, but in years of little or no precipitation yields are reduced by a lack of moisture. Locally, small areas along some of the perennial streams are irrigated. On most farms, shallow wells in glacial drift supply water for domestic and livestock needs. Small ponds and reservoirs are other important sources of water for livestock. In some places, deep wells provide water.

Soils: Most of the soils are Udolls. They are deep and have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Silty Argiudolls (Sharpsburg series) and Hapludolls (Marshall and Monona series) are well drained, nearly level to moderately steep soils on loess-mantled ridgetops and upper side slopes. Loamy Argiudolls (Burchard, Pawnee, and Shelby series) are gently sloping to moderately steep soils that formed in glacial till. Nearly level to gently sloping Argiudolls (Wymore and Grundy series) have a clayey subsoil and formed in loess; they are on uplands. Udorthents (Ida and Steinauer series) are on steep upland slopes. Hapludolls (Kennebec series) and Haplaquolls (Colo and Wabash series) are on bottom lands.

Potential natural vegetation: This area supports grassland vegetation characterized by mid and tall grasses. Big bluestem, little bluestem, switchgrass, indiagrass, porcupinegrass, and sideoats grama are dominant species on silty upland soils. Clayey soils on the uplands support a similar plant community but have a higher percentage of switchgrass and some wildrye. Green ash, hackberry, oak, boxelder, black walnut, and maple trees grow along streams and intermittent drainageways.

107—Iowa and Missouri Deep Loess Hills

Iowa, Kansas, Nebraska, and Missouri

53,810 km² (20,770 mi²)

Land use: Most of this area is in farms, and about 60 percent is cropland. Corn, soybeans, and hay are the principal crops. About 20 percent of the area is permanent pasture. About 10 percent, mainly in narrow belts of steep slopes bordering stream valleys and wet bottom land, is forested. Raising beef cattle and feeding beef cattle and hogs are important enterprises on many farms. The hazard of erosion is severe on the upland soils. Controlling flooding and sedimentation on bottom lands are concerns of management.

Elevation and topography: Elevation ranges from 200 m along the Missouri River flood plain in the south to 500 m on the highest ridgetops in the north. This rolling to hilly, loess-mantled plain is intricately dissected. Small valleys have narrow flood plains, but the larger valleys have broad floors. Local relief is mainly several meters to more than 50 m.

Climate: *Average annual precipitation*—625 to 925 mm. Two-thirds or more of the precipitation falls during the freeze-free period. The low precipitation in winter is mainly snow. *Average annual temperature*—7 to 13°C, increasing from north to south. *Average freeze-free period*—150 to 190 days, increasing from north to south.

Water: The moderate precipitation and abundant streamflow are important sources of water. Ground water is abundant in deep outwash in valleys but is less plentiful on the uplands. The Missouri River is a major transportation artery and is also used for recreation.

Soils: Soils of the uplands are mainly Udolls. Orthents are also extensive. They are deep and medium textured and moderately fine textured and have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Well drained, gently sloping to rolling Hapludolls (Galva, Marshall, and Monona series) and gently sloping to rolling, somewhat poorly drained, Argiudolls (Higginsville series) are on loess-mantled uplands. Somewhat poorly drained, nearly level to gently sloping Hapludolls (Primghar series) and poorly drained, nearly level to gently sloping Haplaquolls (Marcus series) are on loess-mantled uplands. Somewhat excessively drained and well drained, strongly sloping to very steep Udorthents (Hamburg and Ida series) are in thick loess and on uplands. Well drained Hapludolls (Knox series) are in narrow bands on slopes where moisture is favorable for growth of forest vegetation. Moderately well drained, moderately sloping to steep Argiudolls are on side slopes in clay loam glacial till. Well drained and moderately well drained Udifluvents (Haynie

and McPaul series) and Hapludolls (Keg, Kennebec, and Salix series), somewhat poorly drained or poorly drained Fluvaquents (Onawa and Albaton series), and poorly drained or very poorly drained Haplaquolls (Colo, Luton, and Wabash series) formed in alluvium and are extensive on bottom lands.

Potential natural vegetation: This area supports tall prairie grasses. Big bluestem, indiangrass, and switchgrass are major species. Little bluestem and sideoats grama grow well on the steep soils adjacent to the Missouri River. Trees grow throughout the area. Eastern cottonwood, American elm, honeylocust, sycamore, and black walnut are common tree species on the bottom lands. Basswood, red oak, white oak, and shagbark hickory grow on protected upland slopes. Bur oak and bitternut hickory are well adapted to the steep slopes.

108—Illinois and Iowa Deep Loess and Drift

Illinois, Iowa, and Missouri
79,790 km² (30,800 mi²)

Land use: Nearly all this area is in farms, and about 80 percent is cropland. Corn, soybeans, and other feed grains grown extensively on the less sloping soils are sold as cash crops. In areas where slopes are strong, more of the land is used for hay and pasture and more of the grain is fed to livestock on farms where it is grown. About 10 percent of the area is in introduced and native grasses. Making up about 5 percent are narrow bands of forest on steep valley sides and wet bottom land. About 5 percent is used for urban development and other purposes. Conservation practices are used to reduce erosion, flooding, and sedimentation.

Elevation and topography: Elevation ranges from 200 m on the lowest valley floors to 300 m on the highest uplands, increasing gradually from east to west. Much of this dissected loess-mantled glacial plain is rolling to hilly, but some of the broad uplands far from the large streams are level to undulating. The smaller streams have narrow valley floors, but the large streams have broad flood plains. Local relief is mainly several meters to 25 or 50 m, but the upland flats have relief of only 1 or 2 m.

Climate: *Average annual precipitation*—750 to 900 mm. Two-thirds or more of the precipitation falls during the freeze-free period. The low precipitation in winter is mostly snow. *Average annual temperature*—8 to 12°C. *Average freeze-free period*—160 to 180 days.

Water: The favorably distributed moderate precipitation and the many perennial streams are important water sources. Ground water is abundant in the glacial drift that underlies much of the area. The Mississippi River and a few large tributaries are transportation arteries and are used for recreation.

Soils: Most of the soils are Udolls. They are deep, medium textured soils that formed mainly in loess. These soils have a mesic temperature regime, an udic moisture regime, and montmorillonitic or mixed mineralogy. Somewhat poorly drained, nearly level Argiudolls (Flanagan, Ipava, and Mahaska series) and Hapludolls (Muscataine series) and poorly drained nearly level Haplaquolls (Drummer and Sable series), and Argiaquolls (Taintor and Virden series) are on uplands. Well drained and moderately well drained Argiudolls (Sharpsburg, Shelby, and Tama series) are gently sloping to strongly sloping. Well drained Hapludalfs (Fayette, Seaton, Clinton, and Hickory series) on the steep slopes of valley sides make up only 10 to 15 percent of the total area. Somewhat poorly drained Hapludolls (Lawson series), well drained Hapludolls (Huntsville series), and moderately well drained Udifluvents (Nodaway series) are in silty alluvium on the flood plains. Poorly drained and very poorly drained Haplaquolls (Colo and Zook series) are in clayey alluvium on the flood plains.

Potential natural vegetation: When this area was settled, it supported tall grass prairie vegetation. The present potential for natural vegetation is unclear. Forest vegetation consisting of black oak, white oak, bur oak, shagbark hickory, and some walnut grows on the steep slopes of valley sides. Silver maple, elm, and ash grow on flood plains.

109—Iowa and Missouri Heavy Till Plain

Iowa and Missouri
37,110 km² (14,330 mi²)

Land use: Nearly all this area is in farms, and about 55 percent is cropland. Corn, soybeans, other feed grains, and hay are the principal crops. About 25 percent of the area is in introduced and native grasses, and about 10 percent is woodland. Beef cattle and swine are important sources of income on many farms. Conservation practices are used to reduce erosion, flooding, and sedimentation.

Elevation and topography: Elevation ranges from 200 m in the lowest valleys to 300 m on the highest ridges. This dissected till plain has a thin mantle of loess. Slopes are mostly rolling to hilly but some broad ridgetops are nearly level to undulating. The slopes bordering major stream valleys are steep. A few large rivers have nearly level broad valley floors. Local relief is mainly several meters to 25 or 50 m, but the upland flats and valley floors have local relief of only 1 or 2 m.

Climate: *Average annual precipitation*—825 to 1,025 mm. About two-thirds of the precipitation falls during the freeze-free period. The low precipitation in winter is snow. *Average annual temperature*—10 to 13°C. *Average freeze-free period*—160 to 180 days.

Water: In most years the favorably distributed moderate precipitation provides enough water for crops.

The many small perennial streams and a few large streams are additional sources of water but are little used for these purposes. Ground-water supplies are small and undependable. The stream flow fluctuates severely and frequently.

Soils: Most of the soils are Udolls. They are deep and have a medium textured surface layer and a fine textured subsoil. They have a mesic temperature regime, an udic moisture regime, and montmorillonitic mineralogy. Somewhat poorly drained, nearly level to moderately sloping Argiudolls (Haig series) and Ochraqualfs (Kilwinning, Kniffin, and Pershing series) and nearly level to moderately sloping, poorly drained, Argialbolls (Edina series), are on upland divides on loess-covered till plains. Somewhat poorly drained, gently sloping to strongly sloping Argiudolls (Adair, Lagonda, and Lamoni series) and poorly drained, gently sloping to strongly sloping Argiaquolls (Clarinda series) are on convex side slopes with a thin mantle of loess or pedisegment over glacial till. Well drained and moderately well drained, moderately sloping to steep Argiudolls (Shelby series) and Hapludalfs (Armster, Armstrong, Gara, Keswick, and Lindley series) are on side slopes on clay loam glacial till. Moderately well drained Hapludolls (Kennebec and Lawson series) and Udifluvents (Nodaway series) are on silty alluvium flood plains. Poorly drained and very poorly drained Haplaquolls (Chequest, Colo, Zook, and Wabash series) and somewhat poorly drained Argialbolls (Vesser series) are on clayey alluvium flood plains.

Potential natural vegetation: This area supports grassland vegetation. Big bluestem, indiangrass, little bluestem, and switchgrass are the major species. The natural drainageways and the lowland soils interspersed throughout the area support forest vegetation. Oak and hickory species are dominant. Most of the native grasses have disappeared because of cultivation and overgrazing. Naturalized bluegrass is prevalent on noncultivated areas.

110—Northern Illinois and Indiana Heavy Till Plain

Illinois, Indiana, and Wisconsin
26,350 km² (10,170 mi²)

Land use: Most of this area is in farms, but about 25 percent in the north, consisting of Chicago and its suburbs, is used for urban development. Some land formerly used for crops is rapidly becoming urbanized. Farmed areas are used mainly for cash-grain crops. Corn and other feed grains are the principal crops. Woodland occupies less than 5 percent of the area and is mainly on wet flood plains, on steeply sloping valley sides, and on morainic ridges. Controlling wetness, erosion, flooding, and sedimentation are major concerns of management in both urban and farm areas.

Elevation and topography: Elevation is about 200

m, increasing gradually from Lake Michigan south. Streams have cut shallow valleys in much of this nearly level to gently sloping glaciated plain. Local relief is a few meters.

Climate: *Average annual precipitation*—750 to 900 mm. About two-thirds of the precipitation falls during the freeze-free period. Precipitation in winter is snow. *Average annual temperature*—9 to 11°C. *Average freeze-free period*—About 160 days, but it is 180 days in a narrow belt along Lake Michigan.

Water: In most years, the favorably distributed moderate precipitation is adequate for crops. Abundant ground water in the glacial drift meets domestic and municipal needs in much of the area. The large cities in the north depend on Lake Michigan for water. A few large perennial streams are potential sources of water but are little used for this purpose.

Soils: Most of the soils are Udolls, and some are Aquolls. They are deep and moderately deep, fine, moderately fine, and medium textured and have a mesic temperature regime and mixed or illitic mineralogy. Well drained, gently sloping and moderately sloping Argiudolls (Saybrook and Varna series) are on the thinly loess-covered glacial till uplands. Somewhat poorly drained Argiudolls (Elliott, Swygert, and Clarency series) are nearly level or gently sloping. Poorly drained Haplaquolls (Ashkum, Bryce, and Drummer series) are on flats and in depressions. Very poorly drained Medisaprists (Houghton and Lena series) are in wet depressions, but they are not extensive. On outwash underlain by silt, sand, and gravel are loamy, well drained and moderately well drained Argiudolls (Plano, Proctor, and Warsaw series), somewhat poorly drained Argiudolls (Brenton and Elburn series), and well drained Hapludalfs (Fox series). Well drained and moderately well drained, gently sloping to strongly sloping Hapludalfs (Morley and Miami series) are on uplands covered by a thin mantle of glacial till; somewhat poorly drained Ochraqualfs (Blount series) are associated soils in nearly level areas.

Potential natural vegetation: When this area was settled, about 60 percent of the total acreage supported prairie vegetation. The present potential for natural vegetation in prairie sections of the area is unknown. Cattails, bulrushes, and common reed grow on organic soils in marshes. A few bogs support tamarack, pitcherplant, sundew, cranberry, leatherleaf, winterberry, and dwarf birch.

111—Indiana and Ohio Till Plain

Illinois, Indiana, Ohio, and Michigan
84,980 km² (32,810 mi²)

Land use: More than 90 percent of this area is in farms, and about 80 percent is cropland. Corn, soybeans, other feed grains, and hay for livestock are the principal crops. Dairying is an important enterprise near cities, and truck and canning crops are

grown extensively on sites where the soils and markets are favorable. Small acreages of permanent pasture and small farm woodlots make up the rest of the farmland.

Elevation and topography: Elevation ranges from 200 to 300 m, increasing gradually from west to east. This gently sloping glacial till plain is broken in places by hilly moraines, kames, and outwash terraces. Relief is mainly a few meters, but in places, hills rise as much as 25 m above the adjoining plains. The few large streams commonly have narrow and shallow valleys.

Climate: *Average annual precipitation*—900 to 1,025 mm. Half or more of the precipitation falls during the freeze-free period. The low precipitation in winter is mostly snow. *Average annual temperature*—10 to 13°C. *Average freeze-free period*—155 to 180 days.

Water: The favorably distributed moderate precipitation is adequate for crops in years of normal precipitation, but in some years yields are reduced by drought. Ground water in glacial deposits is the principal source of water for domestic, industrial, and municipal uses. A few large streams, mainly tributaries of the Ohio River, are potential sources of water but are little used for this purpose. A few lakes in the western part of the area are widely used for recreation.

Soils: Most of the soils are Udalfs and Aqualfs. They are deep and medium textured to fine textured and have a mesic temperature regime, an aquic or udic moisture regime, and mixed or illitic mineralogy. They formed in calcareous loamy glacial till, which is mantled by loess in the southern part of the area. The dominant soils are gently sloping to moderately sloping, moderately well drained or well drained Hapludalfs (Cardington, Miami, Miamian, Morley, and Russell series) and nearly level, somewhat poorly drained Ochraqualfs (Blount, Crosby, and Fincastle series). Argiaquolls (Brookston and Pewamo series), Haplaquolls (Drummer series), and Medisaprists (Palms and Houghton series) are on flats and in depressions. Nearly level to moderately sloping Hapludalfs (Fox and Ockley series) are on terraces and outwash plains.

Potential natural vegetation: This area supports hardwood forest vegetation. White oak, pin oak, yellow-poplar, sweetgum, and northern red oak grow on the wetter soils. White oak, yellow-poplar, sweetgum, northern red oak, American beech, sugar maple, and white ash are major species on the better drained soils.

112—Cherokee Prairies

Kansas, Missouri, and Oklahoma
59,410 km² (22,940 mi²)

Land use: Nearly all this area is in farms, and about one-half is cropland. Winter wheat, soybeans, corn, grain sorghum, other feed grains, and hay are the

major crops. Some cotton is grown in a few counties in Oklahoma. About one-third of the area is in pasture grasses and legumes; native grasses grow on the more sloping parts. About one-tenth of the area, the steeper valley slopes and some of the wet bottom land, is woodland. The acreage of woodland in Kansas is considerably less than that in Missouri and in Oklahoma.

Elevation and topography: Elevation ranges from 100 to 400 m. These gently sloping to rolling dissected plains are underlain by sandstone, shale, and limestone. The northern part has a thin mantle of loess. Even though the area is thoroughly dissected, local relief is in meters, and large valleys are about 25 m below the adjacent uplands.

Climate: *Average annual precipitation*—900 to 1,050 mm. Maximum precipitation is from late in spring through autumn. Annual snowfall ranges from about 12 cm in the south to 45 cm in the north. *Average annual temperature*—13 to 17°C. *Average freeze-free period*—190 to 235 days.

Water: In many years the moderate precipitation is adequate for crops and pasture, but in some years summer droughts reduce crop yields. In much of the area, shallow wells are the principal source of water for domestic use and for livestock, but small ponds and reservoirs on individual farms are increasingly important sources of water for livestock. Deep wells, especially in limestone areas, also provide water.

Soils: Most of the soils are Aqualfs and Udolls. They are shallow to deep and medium textured and moderately fine textured. These soils have a thermic temperature regime, an aquic or udic moisture regime, and mixed mineralogy. Somewhat poorly drained nearly level and gently sloping Albaqualfs (Parsons and Taloka series), Argiaquolls (Woodson series), and Argialbolls (Hartwell series) are on clay-mantled uplands. Moderately well drained and well drained, gently sloping and sloping Paleudolls (Dennis and Okemah series), Hapludalfs (Barden and Liberal series), and Argiudolls (Bates and Eram series) are on uplands underlain by silty and sandy shale and sandstone. Well drained, gently sloping Argiudolls (Lula and Catoosa series) are underlain by limestone and are on uplands; shallower and more stony Argiudolls (Clareson series), Haplustolls (Shidler series), and Hapludolls (Coweta and Collinsville series) are on steeper slopes of limestone, sandstone, and loamy shale. Gently sloping to moderately sloping clayey Argiudolls (Summit series) are underlain by clayey shale and clay beds and are on foot slopes. Haplaquolls (Osage series), Hapludolls (Verdigris and Wynona series), and Ochraqualfs (Hepler series) are on the flood plains of most streams.

Potential natural vegetation: The western part of this area supports tall grass prairie vegetation. Big bluestem, little bluestem, indiangrass, and switchgrass are the dominant species. The eastern part and the

valleys in the western part support natural vegetation characterized by trees. Red oak, white oak, and shagbark hickory are major species. Islands of tall grass prairie vegetation are common.

113—Central Claypan Areas

Illinois and Missouri
28,570 km² (11,030 mi²)

Land use: Nearly all this MLRA is in farms, and about 60 percent is cropland. Corn, soybeans, other feed grains, and hay for cattle and other livestock are the main crops. About 10 percent is in permanent introduced and native grasses. An additional 20 percent, mainly on the steeper slopes and on wet bottom land, is forested. About 5 percent is used for urban development; the remainder is used for miscellaneous purposes. Wetness is the major land use problem.

Elevation and topography: Elevation ranges from 200 to 300 m in Missouri and is about 200 m in Illinois, increasing gradually from south to north in both states. This MLRA consists of nearly level to gently sloping silt-mantled old till plains. Stream valleys are shallow, and most of them are narrow. Local relief is mainly a few meters.

Climate: *Average annual precipitation*—About 1,025 mm. About 60 percent of the precipitation falls during the freeze-free period. *Average annual temperature*—13°C. *Average freeze-free period*—180 to 190 days.

Water: In most years the moderate precipitation is adequate for crops. Small to moderate quantities of water are available from ground water. A few large perennial streams are potential sources of water, but they are little used for this purpose. Most of the soils are somewhat poorly drained to poorly drained, and claypans prevent effective artificial drainage on most of them.

Soils: Most of the soils are Aqualfs. They have a deep, medium textured surface layer and a fine textured and moderately fine textured subsoil. These soils have a mesic temperature regime, an aquic moisture regime, and montmorillonitic mineralogy. In areas in Missouri are nearly level, poorly drained Albaqualfs (Putnam series) and gently sloping, somewhat poorly drained Ochraqualfs (Mexico and Leonard series). On some sites in Illinois are nearly level Albaqualfs (Cisne, Cowden, and Wynoose series). Somewhat poorly drained, nearly level and gently sloping Hapludalfs (Bluford and Hoyleton series) and moderately well drained, nearly level and gently sloping Fragiudalfs (Ava series) are on loess-covered old till plains. Well drained and moderately well drained, moderately sloping to steep Hapludalfs (Armstrong, Gara, Keswick, Lindley, and Weller series in Missouri and Hickory series in Illinois) are on side slopes. Fluvaquents (Belknap, Piopolis, and Westerville series) and Udifluvents (Sharon series) are in silty

alluvium. Haplaquolls (Wabash series) are in clayey alluvium on narrow flood plains of small extent.

Potential natural vegetation: When this MLRA was settled, most of the level upland soils supported tall grass prairie vegetation characterized by big bluestem, indiangrass, prairie dropseed, and switchgrass. The present potential for natural vegetation on the level upland soils is unknown. Forests of post oak, swamp white oak, blackjack oak, and pin oak grow on poorly drained soils. White oak, shingle oak, black oak, hickory, white ash, basswood, sugar maple, elm, and walnut grow on the better drained soils. Silver maple, willows, cottonwood, sycamore, elm, pin oak, white oak, hickory, and ash grow on flood plains.

114—Southern Illinois and Indiana Thin Loess and Till Plain

Illinois, Indiana, and Ohio
34,880 km² (13,470 mi²)

Land use: Nearly all this area is in farms, but only about 50 percent is cropland. Corn, soybeans, other feed grains, and hay for dairy cattle and other livestock are the principal crops. Some tobacco is grown as a cash crop in Indiana and in Ohio. About 20 percent of the area is forested, much of which consists of small farm woodlots but some is in large holdings. Most of the remaining farmland is pasture. About 5 percent of the area, mainly along the Ohio River, is used for urban development or for industrial purposes. Conservation practices are used to reduce erosion, sedimentation, and flooding.

Elevation and topography: Elevation ranges from 100 m on valley floors to 400 m on ridgetops. The ridgetops increase gradually in elevation from west to east. This dissected old glacial till plain has a moderately thick mantle of loess. Most of the ridgetops are narrow, but some are broad. Ridge slopes and valley sides are steep. Local relief on the ridgetops is in meters, but stream valleys are tens of meters below the adjoining uplands.

Climate: *Average annual precipitation*—900 to 1,150 mm. Maximum precipitation is in spring and early in summer, and the minimum is from midsummer through autumn. *Average annual temperature*—12 to 14°C. *Average freeze-free period*—180 to 200 days.

Water: In most years the moderate precipitation is adequate for crops, but yields are reduced occasionally by droughts. In most of the area ground water is adequate for domestic, industrial, and municipal needs, but ground water is scarce in places where shale is near the surface. Many small streams are potential sources of water, but they are little used for this purpose.

Soils: Most of the soils are Aqualfs. They are deep and medium textured and have a mesic temperature regime, an aquic moisture regime, and mixed miner-

alogy. Poorly drained Ochraqualfs (Clermont series) are on broad flat uplands in Indiana and in Ohio. Somewhat poorly drained, nearly level and gently sloping Hapludalfs (Bluford series), Glossaqualfs (Vigo series), and Fragiaqualfs (Avonburg series) are on slopes. Moderately well drained and well drained, gently sloping to strongly sloping Fragiudalfs (Ava, Cincinnati, and Rossmoyne series) are on side slopes. Well drained Hapludalfs (Hickory series) are on steeper slopes of the glacial till uplands. Well drained, shallow Hapludolls (Fairmount series) formed in shaly limestone materials and are on valley sides near the Ohio-Indiana state line. Well drained Udifluvents (Haymond series) and somewhat poorly drained Fluvaquents (Belknap, Bonnie, and Wakeland series) are in silty alluvium on relatively narrow flood plains.

Potential natural vegetation: This area supports hardwood forest vegetation. Pin oak, white oak, shingle oak, hickory, sweetgum, and black oak are dominant on the wetter sites. White oak, black oak, red oak, hickory, yellow-poplar, ash, sugar maple, and black walnut grow on the better drained sites. Honeylocust is dominant on soils that formed in shaly limestone materials. Silver maple, cottonwood, sycamore, pin oak, elm, and sweetgum grow along rivers and streams. Black walnut is an abundant species on deep, well drained soils on some small flood plains.

115—Central Mississippi Valley Wooded Slopes

Indiana, Illinois, and Missouri
60,860 km² (23,500 mi²)

Land use: Nearly all this area is in farms, and about 40 percent is cropland. Feed grains and hay for livestock are the principal crops, but grape vineyards and peach and apple orchards are important in some places. About 35 percent of the area is forested, which includes some national forests. Most of the remainder of the farmland is in permanent pasture and native grasses. The hazards of erosion and sedimentation are severe in urban areas near St. Louis and other cities and on the farmland.

Elevation and topography: Elevation ranges from

100 m on the main valley floors to 300 m on the ridgetops. This dissected glacial till plain has rolling narrow ridgetops and hilly to steep ridge slopes and valley sides. The small streams have narrow valleys and steep gradients. The major rivers have nearly level broad flood plains. Valley floors are tens of meters below the adjoining hilltops.

Climate: *Average annual precipitation*—900 to 1,150 mm. About two-thirds of the precipitation falls during the freeze-free period. The maximum is in spring and early in summer and the minimum from mid-summer through autumn. *Average annual temperature*—12 to 14°C. *Average freeze-free period*—180 to 200 days, increasing from north to south.

Water: In most years precipitation is adequate for the crops commonly grown, but in some years yields are reduced by drought. Ground water is the source of water for domestic and livestock needs on farms. The Mississippi, Missouri, and Ohio Rivers are major transportation arteries and are also used for recreation.

Soils: Most of the soils are Udalfs. They are deep and medium textured to moderately fine textured and have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Well drained and moderately well drained Hapludalfs (Alford, Fayette, Menfro, Muren, Weller, and Winfield series) are in silty loess; other Hapludalfs (Gara, Hickory, Keswick, and Lindley series) are in glacial till; and still others (Bloomfield and Princeton series) are in sandy aeolian material. Well drained and moderately well drained Fragiudalfs (Grenada, Hatton, and Hosmer series) are on ridgetops in silty material. Well drained, cherty Paleudalfs (Goss series) weathered from cherty limestone. Somewhat excessively drained shallow Hapludolls (Gasconade series) are on steep slopes. Udifluvents (Eel, Genesee, Haymond, Nodaway, and Sharon series), Fluvaquents (Piopolis, Shoals, and Wakeland series), Haplaquolls (Beaucoup, Darwin, and Wabash series), and Hapludolls (Leta series) are on flood plains.

Potential natural vegetation: This area supports a forest flora consisting mainly of oak and hickory species.

N—EAST AND CENTRAL FARMING AND FOREST REGION

612,230 km² (236,380 mi²)

This borderland region between the north and the south includes the Appalachian mountains, valleys, and dissected plateaus and the Ozarks. The average annual precipitation is 1,025 to 1,275 mm in much of the region but ranges from 900 mm along the western edge to 1,525 mm or more in some of the higher mountains in the east. The average annual temperature is 9 to 17°C. The freeze-free period is 180 to 200 days in a large part of the region but ranges from about 140 days in the northeast to as long as 240 days in some of the valleys in the south. Udults and Udalfs on uplands are the most extensive soils. The Udults are on deeply weathered stable landforms. Fluvents along streams are not extensive, but they are cropped intensively throughout the region. Ochrepts are extensive on mountain slopes and on dissected plateaus. Udalfs and Udolls are in limestone valleys and basins, but their total area is small.

Small general farms are characteristic of much of the region, but large dairy and livestock farms are on the more favorable soils. Corn, soybeans, small grains, and hay are the chief crops. Tobacco is an important cash crop, especially in the eastern two-thirds of the region. Steeply sloping land, nearly one-half of the region, is mainly forests used for both recreation and timber production. A large part of the Nation's coal is mined in this region.

116A—Ozark Highland

Arkansas, Missouri, and Oklahoma

69,810 km² (26,950 mi²)

Land use: About 70 percent of this area is forests or woodland, most of which is in large holdings, national forests, or farm woodlots. About 20 percent is pasture, mainly of introduced grasses and legumes. About 10 percent is cropland. Corn, feed grains, and hay for dairy cattle and other livestock are the principal crops. Orchards, vineyards, and truck crops are important on some of the more friable deep soils. Summer droughts and steep slopes are major land use problems.

Elevation and topography: Elevation ranges from 200 to 500 m. These sharply dissected limestone plateaus have narrow rolling ridgetops that break sharply to steep side slopes. Valleys are narrow and have steep gradients, especially in the upper reaches. Local relief is in meters to tens of meters.

Climate: *Average annual precipitation*—1,025 to 1,225 mm. Maximum precipitation is in spring and early in summer, and the minimum is in midsummer. *Average annual temperature*—13 to 16°C. *Average freeze-free period*—180 to 200 days.

Water: The moderate precipitation is adequate for crops and pasture. On most farms shallow wells or springs supply water for domestic needs and for livestock, but deep wells are required for large quantities. Water from deep wells is of good quality but is hard. Small ponds on many individual farms provide some water for livestock, and a few large reservoirs are used for flood control and for recreation.

Soils: Most of the soils are Udults and Udalfs. They are deep, medium textured to fine textured, cherty soils that weathered from limestone. They have a mesic

temperature regime, an udic moisture regime, and siliceous or mixed mineralogy. Somewhat excessively drained to well drained Paleudults (Clarksville, Coulstone, Macedonia, Noark, and Poynor series) and Paleudalfs (Peridge and Goss series) are on ridges and side slopes. Moderately well drained, nearly level to moderately steep Fragiudults (Captina and Nixa series) are on slopes. Somewhat excessively drained, shallow Hapludolls (Gasconade series) and areas of rock outcrop are on steep, dissected landscapes. Udifluvents (Midco and Elsah series) on flood plains and Hapludalfs (Razort and Secesh series) on terraces are in stream valleys. Fine textured Hapludults (Agnos and Gassville series), Paleudalfs (Gepp series), and Paleudults (Doniphan series) also occur.

Potential natural vegetation: This area supports oak-hickory and oak-hickory-pine forests. Oak-hickory-pine forests are more dominant in the east. Glades, openings having bedrock outcrops or that are shallow to bedrock, support a more herbaceous vegetation consisting primarily of indiagrass, little bluestem, and dropseeds. Glades are more common in the southwest.

116B—Ozark Border

Missouri

35,470 km² (13,690 mi²)

Land use: About 40 percent of this area is cleared of timber and brush and is cultivated. Forage and grain are grown as feed for beef, dairy cattle, and other livestock. Corn, soybeans, sorghum, small grain, grass, alfalfa, and other legumes are the major crops. About 35 percent of the area consists of forests or woodland, most of which is in farm woodlots and large holdings. About 25 percent is permanent pasture of introduced grasses and legumes. Summer

droughts and susceptibility of the soils to erosion are major land use problems.

Elevation and topography: Elevation ranges from 200 to 500 m. These broad limestone ridges and remnants of plateaus have gently sloping to moderately sloping tops and strongly sloping to steep side slopes. The stream valleys are narrow to moderately wide and have relatively steep gradients. Local differences in elevation range from 1 to 10 meters.

Climate: *Average annual precipitation*—975 to 1,225 mm. Maximum precipitation is in spring and early in summer, and the minimum is in midsummer. *Average annual temperature*—13 to 16°C. *Average freeze-free period*—180 to 200 days.

Water: In many years the moderate precipitation is adequate for crops and pastures, but summer droughts of sufficient severity and duration to reduce crop yields are common. On most farms shallow wells or springs supply water for domestic needs and for livestock, but deep wells are required for large quantities. Water from deep wells is of good quality but is hard. Small ponds on many individual farms provide some water for livestock, and a few large reservoirs are used for flood control and for recreation.

Soils: Most of the soils are Udalfs or Udufts. They are moderately deep, medium textured to fine textured, cherty, limestone soils that are partly covered with a thin mantle of loess. They have a mesic temperature regime, an udic moisture regime, and siliceous or mixed mineralogy. Well drained, nearly level to moderately sloping Fragiudalfs (Hobson, Lebanon, Viraton, and Wilderness series), poorly drained, nearly level to moderately sloping Fragiaqualfs (Bado and Gerald series), and well drained Fragiudults (Captina and Nixa series) are on the broad tops of upland ridges. Well drained Hapludalfs (Barco, Bardley, and Bolivar series) are also on upper parts of ridgetops and side slopes on the uplands, and well drained Paleudalfs (Eldon and Goss series) and Paleudults (Clarksville series) are on the steeper and lower parts of side slopes and hillsides. Well drained, nearly level Hapludolls (Cedargap series) and Udi-fluents (Elsah and Sharon series) are on bottom lands. Well drained Hapludalfs (Ashton, Razort, and Waben series) and Paleudalfs (Britwater series) occupy stream terraces.

Potential natural vegetation: This area supports oak-hickory savanna vegetation. It is a transitional area between oak-hickory forests and bluestem prairies. Big bluestem, little bluestem, indiangrass, and switchgrass are the dominant grassland species. The forests and grasslands are interspersed. The oak-hickory forests are more common on north slopes and on deeper soils and the grasslands on south slopes and on soils with low available moisture capacity.

117—Boston Mountains

Arkansas, and Oklahoma

14,930 km² (5,770 mi²)

Land use: About 76 percent of this MLRA is forested, mainly in farm woodlots but large tracts in Arkansas are national forests. About 16 percent is grazing land, 6 percent is cropland, and 2 percent is used for miscellaneous purposes. Small grains and hay crops for livestock are the main crops. Peach and apple orchards are important locally. Pastures are mostly of tame grasses and legumes but native grasses grow on the prairie outliers in the west.

Elevation and topography: Elevation ranges from 200 m on the lowest valley floors to 800 m on the highest ridge crests. Ridgetops of these deeply dissected sandstone and shale plateaus are narrow and rolling. Valleys are narrow and steep sided and have steep gradients. Local relief is in tens of meters.

Climate: *Average annual precipitation*—1,150 to 1,325 mm. Maximum precipitation is in spring and in fall, and the minimum is in midsummer. *Average annual temperature*—14 to 17°C. *Average freeze-free period*—180 to 205 days.

Water: The moderately high precipitation is adequate for crops and pastures. Shallow wells are the principal source of water for domestic use. Small ponds on individual farms provide water for livestock, and springs are numerous on the mountainsides and in the valleys. Deep wells are needed for moderate to large quantities of ground water. Large reservoirs on a few of the major streams are sources of municipal water and also provide flood control and recreation.

Soils: The major soils are Udufts. They are stony and nonstony and medium textured. These soils have a thermic temperature regime, an udic moisture regime, and siliceous or mixed mineralogy. Well drained, shallow and moderately deep Hapludults (Mountainburg and Linker series) are on ridgetops, benches, and upper slopes. Well drained, deep Paleudults (Nella series) and Hapludults (Enders series) are on the middle and lower slopes and in concave interledge positions. Udi-fluents (Ceda series) and Hapludults (Spadra series) are on stream flood plains, and Fragiudults (Leadvale and Taft series) and Hapludults (Pickwick series) are on terraces in the valleys.

Potential natural vegetation: This area supports hardwood forests. The primary overstory species are red oak, white oak, and hickory. Shortleaf pine and eastern redcedar are important on disturbed sites, on shallow soils, and on south or west slopes. Big bluestem, switchgrass, indiangrass, and little bluestem are important understory species under medium to open forest canopy. Broadleaf uniola, longleaf uniola, wildryes, and low panicums are important species under heavy canopy.

118—Arkansas Valley and Ridges

Arkansas and Oklahoma
27,250 km² (10,520 mi²)

Land use: About 57 percent of this MLRA is forested. About one-third of the wooded area is federally owned, and most of the other two-thirds consists of farm woodlots. Twenty-six percent of the MLRA is grazed land, 11 percent is cropland, and 6 percent is used for miscellaneous purposes. Most of the cropland is in the less sloping valleys areas, but some is on flat mountain tops. Small grains and hay are the major crops. Soybeans are an important crop on the Arkansas River bottom land. Orchards, vineyards, and vegetable crops are important locally. Pastures on the bottom land of small streams and throughout cleared parts of the uplands consist of a mixture of tame and native grasses and legumes.

Elevation and topography: Elevation ranges from 100 m on the lowest valley floors to 900 m on some mountain tops. These ridges and valleys are underlain by slightly folded to level beds of sandstone and shale. Ridge slopes are steep; most crests are narrow and rolling, but some are broad and flat. The intervening valleys are broad and smooth. Local relief is in meters in the valleys and on the flat ridgetops. The ridges and mountains rise sharply tens of meters above adjacent valleys.

Climate: *Average annual precipitation*—1,125 to 1,275 mm. Maximum precipitation is in spring and in autumn. *Average annual temperature*—16 to 17°C. *Average freeze-free period*—200 to 240 days.

Water: The moderate precipitation generally is adequate for crops and pasture. On the uplands, water for domestic use comes mainly from shallow wells and water for livestock from small ponds on individual farms. In the valleys, springs, shallow wells, small ponds, and perennial streams provide water for most uses. Deep wells yield large quantities of hard water, but in areas of shale bedrock ground water is scarce.

Soils: The major soils are Udults. They are stony and nonstony and medium textured. These soils have a thermic temperature regime, an udic moisture regime, and siliceous or mixed mineralogy. Well drained, shallow and moderately deep Hapludults (Mountainburg and Linker series) are on ridgetops, benches, and upper slopes. Well drained, deep Hapludults (Enders series) and Paleudults (Nella series) are on middle and lower slopes and in concave interledge positions. Fragiudults (Leadvale, Taft, and Cane series) are in the valleys. Udifluvents (Roxana series), Udipsamments (Crevasse series), Haplaquolls (Roellen series), and Hapludalfs (Gallion series) are minor soils along the Arkansas River, and Dystrochrepts (Barling series) and Hapludults (Spadra and Pickwick series) are minor soils on terraces along smaller streams.

Potential natural vegetation: This area supports

hardwood forests. The primary overstory species are red oak, white oak, and hickory. Shortleaf pine is important on disturbed sites, on shallow soils, and on sites having a south or west aspect. Big bluestem, switchgrass, indiangrass, and little bluestem are important understory species under medium to open forest canopy. Broadleaf uniola, longleaf uniola, wildryes, and low panicums are important species under heavy canopy.

119—Ouachita Mountains

Arkansas and Oklahoma
24,640 km² (9,510 mi²)

Land use: About 76 percent of this MLRA is forested, about one-fourth of which, mainly in Arkansas, is federally owned. Some is in large holdings, but much of it is in farm woodlots. Lumbering, wood-using industries, and recreation are important throughout the area. Seventeen percent of the MRLA is grazing land, about 5 percent is cropland, and 2 percent is used for miscellaneous purposes. Forage and small grains are the major crops. Pastures are largely a mixture of tame grasses and legumes, but on some small prairie outliers in the west pastures are of native grasses.

Elevation and topography: Elevation ranges from 100 m on the lowest valley floors to 800 m on the highest mountain peaks. These steep mountains are underlain by folded and faulted shale, slate, quartzite, sandstone, and chert. Most of the stream valleys are narrow and have steep gradients, but wide terraces and flood plains border the Ouachita River in western Arkansas. Local relief is in tens of meters to more than 300 meters.

Climate: *Average annual precipitation*—1,225 to 1,425 mm, decreasing to 900 mm along the western edge. Precipitation is fairly evenly distributed throughout the year, but the maximum is in spring and early in autumn. *Average annual temperature*—16 to 17°C. *Average freeze-free period*—200 to 240 days.

Water: The high precipitation, perennial streams, and reservoirs provide abundant water. Several large reservoirs for water storage and flood control are also used for recreation. In the valleys, small ponds, springs, and shallow wells are the main sources of water for domestic use and for livestock.

Soils: The major soils are Udults. They are stony and nonstony and medium textured. These soils have a thermic temperature regime, an udic moisture regime, and siliceous or mixed mineralogy. Well drained, shallow and moderately deep Hapludults (Townley, Pirum, and Sherwood series) are at the higher elevations and on steeper slopes. Well drained, deep and moderately deep Hapludults (Carnasaw, Pirum, and Sherwood series) are on the gentle slopes of ridgetops, benches, and foot slopes. Dystrochrepts (Ouachita series) and Ochraqults (Amy series) on flood plains

and Hapludults on terraces in the valleys are minor soils.

Potential natural vegetation: This area supports hardwood-pine forests. The primary overstory species are southern red oak, black oak, white oak, and hickories. Pine constitutes as much as 40 percent of the cover—shortleaf pine on the uplands and loblolly pine on the lower lying alluvial soils. Switchgrass, little bluestem, and indiangrass are the primary grass species in the understory. Prairie cordgrass, plumegrass, low panicums, sedges, and rushes are present in smaller amounts.

120—Kentucky and Indiana Sandstone and Shale Hills and Valleys

Indiana and Kentucky
30,990 km² (11,970 mi²)

Land use: Most of this area consists of small and medium-size farms. A large part in Indiana is in the Hoosier National Forest; some large tracts belong to coal mining companies. About 40 percent of the area is cropland, but the acreage varies widely from county to county, depending largely on the topography. Corn, soybeans, and wheat are the major crops, but tobacco is important in some parts. About 40 percent of the area is in forests of mixed hardwoods, but forest products are important in only a few parts of the area. About 17 percent is pasture used mostly for beef cattle. Urban development is minor. Stabilizing strip mine spoil is a major concern of management.

Elevation and topography: Elevation ranges from 100 m on the Ohio River flood plain to about 200 m on the higher ridges. Local relief generally is 50 to 100 m between ridgetops and the flood plains of local streams. The area is mostly hilly with broad undulating ridgetops on major divides. The flood plains and terraces of the Ohio River and its tributaries are nearly level to sloping.

Climate: *Average annual precipitation*—1,175 mm. About 525 mm falls during the growing season. The variable snowfall averages 25 cm. *Average annual temperature*—14°C. *Average freeze-free period*—185 days.

Water: Water is abundant in most of the area. In most years precipitation is adequate for crops. In some years, however, droughts reduce yields, and in others, too much rainfall delays planting or interferes with harvesting operations. The large streams and constructed lakes supply most of the urban water, and waterlines supply much of the water to nearby rural communities. Large quantities of ground water are available in the valley of the Ohio River and its major tributaries, but only small quantities are locally available throughout the rest of the area.

Soils: Most of the soils are Udalfs. They are medium textured and moderately fine textured. These soils

have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. They formed in loess and in residuum from sandstone, shale, and siltstone. Fragiudalfs (Grenada and Zanesville series), which have a fragipan, and Hapludalfs (Wellston and Frondorf series) are the dominant soils on ridgetops and side slopes. Fragiudults (Tilsit series) and Hapludults (Gilpin series) are in the northern part of the area. Hapludolls (Huntinton series), Eutrochrepts (Nolin series), and Fluvaquents (Melvin series) are loamy soils on flood plains of major streams. Haplaquepts (Karnak series) are clayey soils in slack water areas. Dystrochrepts (Cuba series), Udifluvents (Haymond series), and Fluvaquents (Stendal and Wakeland series) are loamy soils on flood plains of local origin. Hapludalfs (Wheeling series) and Fragiudalfs (Otwell series) are loamy soils on terraces of the major streams.

Potential natural vegetation: This area supports oak-hickory forest vegetation on the rolling plateau. Coves and cooler slopes support mixed hardwood vegetation of beech, sugar maple, yellow-poplar, white ash, and red and white oak. Eastern redcedar often grows on the shallower limestone soils. Such bottom land hardwoods as cottonwood, cherrybark oak, pin oak, Shumard oak, sweetgum, and swamp white oak are on flood plains.

121—Kentucky Bluegrass

Indiana, Kentucky, and Ohio
29,490 km² (11,390 mi²)

Land use: Most of this area consists of small and medium-size farms. Urbanization is minor except near Louisville, Lexington, and Cincinnati. About 30 percent of the area is cropland, but the acreage varies widely from county to county, depending largely on the topography. Corn, hay, and tobacco are the major crops. About 45 percent of the area is pasture grazed mostly by beef cattle, but dairying and horse farms are important in some places. About 20 percent is mixed hardwood forest vegetation, but wood products are not important.

Elevation and topography: Elevation ranges from about 200 m on the Ohio River flood plain to about 300 m on the higher ridges near Lexington. The topography ranges from highly dissected hills that have local relief of about 50 to 100 m to undulating broad upland plains that have local relief of about 25 m.

Climate: *Average annual precipitation*—About 1,125 mm. About one-half of the precipitation falls during the growing season. The variable snowfall averages about 37 cm. *Average annual temperature*—About 13°C. *Average freeze-free period*—About 180 days.

Water: Water is abundant in most of the area. In most years, precipitation is adequate for crops, but in some years, yields are reduced by droughts. The large

streams and constructed lakes supply most of the water in urban areas, and waterlines supply much of the water in nearby rural communities. Farm ponds, wells, and cisterns are the major sources of water in other rural communities. Large quantities of ground water are available in the valley of the Ohio River and its major tributaries, but only small quantities are locally available throughout the rest of the area.

Soils: Most of the soils are Udalfs. They are fine textured and moderately fine textured and have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. The dominant great groups are Hapludalfs (Eden and Lowell series), Paleudalfs (Maury and Crider series), Fragiudalfs (Nicholson series), and Hapludolls (Fairmount series). These soils formed in residuum from limestone or from thin bedded shale, siltstone, and limestone and in loess over residuum on hillsides, ridgetops, and upland plains. They are generally moderately deep to very deep, but the Fairmount soils are shallow. Loamy Hapludolls (Huntington series), Eutrochrepts (Nolin series) and Fluvaquents (Newark series) are on flood plains. Loamy Hapludalfs (Wheeling and Elk series) and Fragiudalfs (Otwell series) are on stream terraces.

Potential natural vegetation: This area supports mixed hardwood forest vegetation, generally on the better sites. Chinkapin oak, bur oak, blue ash, Shumard oak, white ash, hackberry, American elm, black walnut, black cherry, black locust, and Kentucky coffeetree are important species. Eastern redcedar is dominant on the drier slopes and on abandoned farmland.

122—Highland Rim and Pennyroyal

Alabama, Indiana, Tennessee, and Kentucky

52,640 km² (20,320 mi²)

Land use: Most of this area consists of small and medium-size farms. Urbanization is relatively small. Extensive forests are on the deeply dissected hills surrounding the Nashville Basin and along the western edge joining the Coastal Plain. Elsewhere, the forests consist mostly of small farm woodlots. Hay and pasture for beef cattle are the principal crops. Corn and soybeans, grown mostly on narrow strips of bottom land and on upland flats, are important locally. Tobacco, especially burley, is an important cash crop.

Elevation and topography: Elevation is 200 to 300 m, ranging from about 100 m along the deepest valley floors to about 400 m on the crest of isolated hills. The area is greatly diversified with low rolling hills, upland flats, and narrow valleys. Steep slopes occur where the encircled Nashville Basin cuts into the area and along the western edge bordering the Coastal Plain. Elsewhere, except for steep walls and hillsides along deeply cut stream channels, the topog-

raphy is predominantly gently rolling to strongly rolling with a few interruptions by broad upland flats and shallow basins. In many places the land surface is pitted by limestone sinks.

Climate: *Average annual precipitation*—1,125 to 1,375 mm. Maximum precipitation is in winter and early in spring, and the minimum is in fall. *Average annual temperature*—13 to 16°C, decreasing from south to north. *Average frost-free period*—180 to 205 days, decreasing from south to north.

Water: In most years, precipitation is adequate for crops, but in some years, yields are reduced by short dry periods early in summer. The numerous perennial streams and lakes supply abundant water to much of the area. Several medium to large lakes constructed by the U.S. Corps of Engineers provide flood control, power production, recreation, and water for municipalities. In some parts where surface water is scarce, the water comes mainly from wells, large springs, and farm ponds. In many places, waterlines from metropolitan areas extend far into the countryside.

Soils: Most of the soils, southward from about the Kentucky-Tennessee border, are Udults that have a thermic temperature regime, an udic moisture regime, and siliceous and kaolinitic mineralogy. Udalfs and Udults of mesic temperature regime, udic moisture regime, and mixed mineralogy are dominant in Kentucky and in Indiana. The soils generally are very deep to cherty limestone and strongly acid and highly leached and have a subsoil rich in clay. In the southern part, well drained, cherty Paleudults (Baxter, Bodine, and Fullerton series) are on hillsides, and moderately well drained Fragiudults (Dickson and Sango series) are on upland flats. Fragiquults (Guthrie series) are in small basins and depressions, and Dystrochrepts (Ennis and Lobelville series) are in narrow strips of bottom land. In the northern part, well drained Paleudults (Baxter and Frederick series) are on hill slopes, well drained Paleudalfs (Crider and Pembroke series) are on broad smooth areas capped with loess, and moderately well drained Fragiudults and Fragiudalfs (Bedford, Nicholson, and Lawrence series) are on upland flats. On the narrow strips of bottom land are mainly Hapludolls (Huntington series), Udifluvents (Haymond series), and Eutrochrepts (Nolin series). In the extreme northernmost part in Indiana, a sizable area is underlain by shale, sandstone, and limestone; loamy-skeletal Dystrochrepts (Weikert and Berks series) and Hapludults (Gilpin series) are on the slopes, and Hapludalfs (Wellston series) and Fragiudalfs (Zanesville series) are on upland flats capped with loess.

Potential natural vegetation: This area supports oak-hickory forests. Yellow-poplar is common on the deeper soils. Understory plants include a variety of grasses, forbs, vines, and shrubs. Little bluestem and broomsedge are dominant grass species.

123—Nashville Basin

Tennessee

15,680 km² (6,060 mi²)

Land use: The densely populated Nashville Basin consists mostly of small and medium-size farms. Much farmland has been converted to residential use and to small estate-type farms, particularly around Nashville. Hay, pasture, and some grain for beef cattle and dairy cattle are the principal crops. Small acreages of burley tobacco, cotton, and soybeans are grown. Some large rocky sites, commonly called “Gladly Land,” are in redcedar forest or in redcedar-deciduous brush.

Elevation and topography: Elevation is about 200 m, but isolated hills rise to an elevation of 300 to 400 m. Some of the more deeply cut stream channels are as low as 200 m above sea level. Most of the outer part of the Basin is deeply dissected and consists of steep slopes between narrow rolling ridgetops and narrow valleys. The inner part of the Basin is predominantly undulating and rolling. In many places the land surface is deeply pitted by limestone sinks, and outcrops of limestone rock are almost everywhere.

Climate: *Average annual precipitation*—About 1,275 mm. Maximum precipitation is in midwinter and early in spring, and the minimum is in autumn. *Average annual temperature*—14 to 16°C. The temperature varies little throughout the Basin. *Average freeze-free period*—192 days.

Water: The moderately high precipitation generally provides adequate moisture for crops and pasture, but in some years, short periods of drought in summer reduce pasture and crop yields. Permanent streams and lakes are an important source of water. The Cumberland River has dams for flood control, power production, navigation, and recreation. Ground water from wells and springs is an important source of water for domestic use and for livestock. Farm ponds are used to supplement the water supply, especially in places where surface water is scarce because of limestone sinks.

Soils: Udalfs are the most extensive soils in the Basin, but Udufts occupy a large acreage. These soils have a thermic temperature regime, an udic moisture regime, and a clayey subsoil. Well drained, fine textured Hapludalfs are on hillsides in the outer or phosphatic part of the Basin (Mimosa and Hampshire series) and on low hills in the inner part (Tablott series). Well drained Paleudalfs (Lomond and Cumberland series) occupy a sizable acreage in the inner part of the Basin where there are deposits of alluvium or of alluvium and loess. Dark brown loamy, cherty Hapludults (Dellrose series) are on steep, deeply dissected hills that extend around the rim of the Basin. A small acreage of Rendolls (Gladeville series) in the inner Basin, where the rock is at or near the

surface, is commonly called “Gladly Land.” Hapludolls (Arrington, Lynnville and Egam series) and Haplaquolls (Roellen and Godwin series) are on the inextensive bottom lands. Outcrops of limestone are common.

Potential natural vegetation: This area supports oak-hickory stands. Yellow-poplar grows on the northern slopes, and eastern redcedar and cedar-hardwood stands grow on the limestone glades and rocky, clayey sites. Understory vegetation includes many grasses, forbs, vines, and shrubs. Broomsedge blue-stem is the dominant grass species.

124—Western Allegheny Plateau

Ohio and Pennsylvania

19,040 km² (7,350 mi²)

Land use: Most of this area consists of farms, but about one-fourth is used for other purposes. About one-fifth is cropland. Hay and feed grains for livestock are the principal crops, and fruits and vegetables are important locally. About one-fifth is pasture. Two-fifths is forested, about half of which consists of farm woodlots and about half state and national forests and large commercial holdings. Strip mining of coal is an important industry in the north, but only a small part of the total area is strip mined.

Elevation and topography: Elevation ranges from 200 m on the lowest valley floors to 400 m at the highest ridgetops. The dissected sandstone plateau has narrow level valley floors, rolling ridgetops, and hilly to steep ridge slopes. Local relief is about 50 to 100 m.

Climate: *Average annual precipitation*—1,025 to 1,150 mm. Precipitation is evenly distributed except for a slight maximum late in spring and a minimum late in autumn. *Average annual temperature*—9 to 13°C. *Average freeze-free period*—Mainly 140 to 160 days, but it is 180 days along the southern edge.

Water: The moderate precipitation and many perennial streams supply an abundance of water. Shallow wells and springs are the principal sources of water for domestic and livestock uses. Deep ground water is abundant but is highly mineralized. Reservoirs on many streams provide water for industrial and municipal use for most of the cities in the area and also for some cities in adjoining areas.

Soils: Most of the soils are Ochrepts, Udufts, and Udalfs. They have mixed mineralogy, a mesic temperature regime, and an udic moisture regime. They are on sloping to steep sites and are well drained to moderately well drained. Medium textured, gravelly to very gravelly Dystrochrepts (Muskingum and Dekalb series) formed in residuum derived from acid sandstone interbedded with siltstone and shale. Moderately fine textured Hapludults (Gilpin, Trappist, and Latham series) formed in residuum derived from acid siltstone, shale, and some sandstone. Moderately fine textured to fine textured Hapludalfs (Guernsey, Keene,

and Upshur series) formed in residuum derived mostly from clay, shale, and siltstone.

Potential natural vegetation: This area supports a mixed oak forest vegetation. White oak, black oak, northern red oak, and some scarlet oak are dominant species. Shagbark hickory, bitternut hickory, pignut hickory, and mockernut hickory are also included. Oak, blackgum, flowering dogwood, sassafras, Virginia pine, pitch pine, and shortleaf pine occur mostly on the ridgetops.

125—Cumberland Plateau and Mountains

Alabama, Kentucky, Tennessee, Virginia, and West Virginia
63,840 km² (24,640 mi²)

Land use: Most of this area consists of small and medium-size farms. An extensive acreage in Kentucky is in the Daniel Boone National Forest, and some large tracts are owned by coal and timber companies. Urbanization is minor. About 80 percent of the area is forests of mostly mixed hardwoods. Lumber is an important product. About 8 percent of the area is cropland. Corn, hay, and tobacco are the major crops. About 8 percent is pasture used mostly for beef cattle. Stabilizing strip-mined areas is a major concern of management.

Elevation and topography: Elevation ranges from 200 m on the Ohio River flood plain to about 300 m on nearby ridgetops, gradually rising to near the Virginia-Kentucky border, where local flood plains are about 500 m, and higher mountains are about 1,200 m. The highly dissected landscape is largely a series of long steep side slopes between narrow ridgetops or crests and narrow stream flood plains.

Climate: *Average annual precipitation*—1,175 mm; about 525 mm falls during the growing season. The variable snowfall averages about 50 cm. *Average annual temperature*—13°C. *Average freeze-free period*—175 days.

Water: Water is abundant in most of the area. In most years precipitation is adequate for crops, but in some years yields are reduced by droughts. The large streams and constructed lakes supply most of the urban water. Farm ponds, wells, and cisterns are sources of water in rural communities. Large quantities of ground water are available in the valley of the Ohio River and its major tributaries, but only small quantities are locally available in the rest of the area.

Soil: Most of the soils are Udults. They are medium textured to fine textured. These soils have a mesic temperature regime, an udic moisture regime, and mixed or siliceous mineralogy. Hapludults (Shelocta, Jefferson, Clymer, Gilpin Latham, Lily, and Hartsells series) and Fragiudults (Tilsit series) on side slopes and ridges formed in loamy hillside colluvium or residuum. Medium textured, very gravelly Dystrochrepts (Dekalb, Berks, and Calvin series) are on

upper side slopes and ridges. Loamy Dystrochrepts (Pope series) and Fluvaquents (Bonnie series) are on flood plains. Loamy Hapludults (Allegheny series) and Fragiudults (Monongahela series) are on stream terraces.

Potential natural vegetation: This area supports a variety of woody and herbaceous plant communities. Mixed hardwood forest vegetation is in coves and on north- and east-facing slopes. Yellow-poplar, beech, black walnut, basswood, red and white oaks, hemlock, and buckeye are among the 20 or more tree species. Oak-hickory communities, shortleaf pine, pitch pine, and Virginia pine are on ridges and on south- and west-facing slopes. Willows, sycamore, sweetgum, and river birch grow on flood plains.

126—Central Allegheny Plateau

Ohio, Pennsylvania, and West Virginia
50,770 km² (19,600 mi²)

Land use: Most of this area consists of farms, but less than one-half of the area consists of income-producing farms. The farm income is predominantly from beef cattle and dairy farms associated with hay, grassland, and cultivated crops. About one-half of the area is forested, and the sale of timber is important in some parts. Urban expansion, including industrial and residential developments, is increasing along the Ohio River and major tributaries. Much of the cropland has been converted to this purpose. Large acreages are owned or leased for strip mining of coal.

Elevation and topography: Elevation ranges from 200 m on the lowest valley floors to 400 m or more at the highest ridgetops. The dissected plateau is underlain mainly by horizontal bedded sandstone, siltstone, and shale and a few layers of limestone. The narrow, level valleys and narrow, sloping ridgetops are separated by long, steep to very steep side slopes. Relief locally is about 100 m.

Climate: *Average annual precipitation*—900 to 1,150 mm. Precipitation is somewhat unevenly distributed. The maximum is in midsummer and the minimum in autumn and early in winter. Annual snowfall ranges from less than 90 cm to more than 127 cm. *Average annual temperature*—4 to 13°C. *Average freeze-free period*—120 to 170 days.

Water: Water from springs, wells, farm ponds, reservoirs, and cisterns is plentiful. Large quantities of ground water can be obtained from deep wells, but the water generally is highly mineralized. Improved environmental practices are helping solve the problem of stream pollution from coal mine and other industrial wastes.

Soils: Most of the soils are Udalfs, Udults, and Ochrepts. They are mostly well drained and moderately well drained, moderately deep and deep, medium and fine textured soils on uplands. They have a mesic temperature regime, an udic moisture regime, and mixed

mineralogy. Sloping to steep Hapludalfs (Westmoreland, Culleoka, Upshur, and Guernsey series) formed in material weathered from lime-influenced siltstone, shale, and fine grained sandstone. Sloping to very steep Hapludults (Gilpin series) and Dystrochrepts (Berks and Dekalb series) formed in material weathered from acid sandstone, siltstone, and shale on uplands.

Potential natural vegetation: This area supports deciduous forest vegetation. White oak, red oak, black oak, hickory, and associated upland hardwoods are major species. Scarlet oak, chestnut oak, and hickory, along with scattered Virginia pine, shortleaf pine, and white pine, grow on dry ridges and on the shallower soils. Yellow-poplar, black walnut, red oak, red maple, and other species requiring much moisture grow in sheltered coves, on foot slopes, and on north-facing slopes.

127—Eastern Allegheny Plateau and Mountains

Maryland, Pennsylvania, and West Virginia
43,680 km² (16,870 mi²)

Land use: Most of this area consists of farms; about 8 percent is cropland. Corn, small grains, and forage for dairy and beef cattle are the principal crops. Other important crops include potatoes and soybeans. Dairy, beef, and poultry farms are important enterprises. About 3 percent of the area is hardwood forests, most of which is privately owned, although there are large blocks of state forest and game lands and national forests. About 6 percent consists of urban areas and disturbed land, including strip mines. Stabilizing and revegetating strip-mined areas and controlling acid drainage water from coal mines are major concerns of management.

Elevation and topography: Elevation ranges from 300 m in the lowest valleys to 600 to 800 m over much of the plateau top; mountains in the southeast are 1,100 to 1,400 m. This deeply dissected plateau terminates in a high escarpment in the east. Steep slopes are dominant, but level to gently rolling plateau remnants are conspicuous in the north. Local relief is mainly about 100 m, but some mountain peaks in the south rise 300 m or more above the plateau or adjacent valleys.

Climate: Average annual precipitation—1,025 to 1,425 mm. Maximum precipitation is in spring and in summer, and the minimum is in fall. Precipitation averages 550 to 825 mm during the growing season. The average snowfall ranges from 90 cm in the south to more than 227 cm in the north. *Average temperature*—7 to 11°C. *Average freeze-free period*—110 to 160 days. The shorter growing seasons occur at the higher elevations and in the north.

Water: Water from springs, wells, farm ponds, reservoirs, and streams is plentiful. The major rivers

include the Youghiogheny, North Branch of the Potomac, West Branch of the Susquehanna, and the Allegheny. Several large reservoirs include Deep Creek Lake, Youghiogheny River Reservoir, and Allegheny Reservoir. Ground water is plentiful, although well yields are highly variable in the sandstone and shale bedrock.

Soils: Most of the soils are Ochrepts, Udults, and Aquults. They have a mesic temperature regime, an udic or aquic moisture regime, and mixed mineralogy. Nearly level to steep Dystrochrepts (Calvin, Dekalb, and Hazleton series), Hapludults (Clymer, Gilpin, and Wharton series), and Fragiudults (Cookport series) formed in material weathered from acid sandstone, siltstone, and shale on the plateau and on the upper mountain slopes. The Dystrochrepts are medium textured and very gravelly. The Udults are medium textured to fine textured. Nearly level to gently sloping, medium textured Dystrochrepts (Pope and Philo series) of lesser extent formed in alluvium along streams and are susceptible to periodic stream overflow. Somewhat poorly drained, fine textured, nearly level to sloping Ochraquults (Cavode series) formed in material weathered from shale on the plateau or along the foot slopes.

Potential natural vegetation: This area supports a mixed hardwood forest vegetation. Oak, black cherry, yellow-poplar, maple, and other associated hardwoods are the principal species at lower elevations. White pine, Virginia pine, and black walnut also grow but are of lesser extent. Red spruce, hemlock, birch, and maple species grow on the high mountain soils. Sugar maple, black cherry, and red oak commonly grow at intermediate elevations.

128—Southern Appalachian Ridges and Valleys

Alabama, Georgia, Tennessee, Virginia, and West Virginia
69,430 km² (26,810 mi²)

Land use: Most of this area consists of small and medium-size farms. About 40 percent is forests of mixed hardwoods, most of which, except for a few wooded mountain ridges, are in small farm woodlots. A large acreage in Virginia is in the George Washington and Thomas Jefferson National Forests. Hay, pasture, and some grain for beef cattle and dairy cattle are the principal crops. Burley tobacco is the important cash crop in the southern two-thirds of the area (excluding Georgia). Some cotton is grown south of Chattanooga. Small acreages of corn and soybeans are grown throughout the area, mainly on narrow strips of bottom land and on adjacent low terraces.

Elevation and topography: Elevation ranges from 200 m near the southern end to more than 600 m in Central Virginia. Some isolated linear mountain ridges rise to nearly 1,500 m above sea level. The area is highly diversified. It consists of many parallel ridges,

narrow intervening valleys, and large bodies of low, irregular hills. The ridges and valleys often have a difference in elevation of 200 m. The western side of the area is dominantly hilly to very steep and is rougher and much steeper than the eastern side, much of which is rolling and hilly.

Climate: *Average annual precipitation*—925 to 1,400 mm. Maximum precipitation is in midwinter and in midsummer, and the minimum is in autumn. *Average annual temperature*—13 to 16°C. *Average freeze-free period*—170 to 210 days.

Water: Precipitation generally is adequate for crops and for other needs. Short dry periods early in summer occasionally reduce crop yields. Permanent streams, originating in the mountainous regions on either side, carry water to nearly all parts of the area. Several dams, constructed by the Tennessee Valley Authority on the Tennessee River and its major tributaries, provide flood control, navigation, power production, and recreation. Shallow wells, supplemented locally by springs and ponds, are important sources of water for farmstead use.

Soils: Most of the soils are Udults and, to a lesser extent, Ochrepts. They have an udic moisture regime and a thermic or mesic temperature regime. The soils dominantly are well drained, strongly acid, and highly leached and have a clay-enriched subsoil. They range from shallow on the sandstone and shale ridges to very deep in the valleys and on the large limestone formations. Paleudults (Dunmore, Decatur, Dewey, Frederick, and Fullerton series, commonly cherty) are on the numerous and extensive areas underlain by limestone that traverse the region in a southwest-northeast direction. Hapludults (Sequoia series) are dominant in the valleys underlain by acid shale. Steep, shallow to moderately deep, shaly and stony Dystrochrepts (Muskingum, Weikert, Wallen, Litz, Lehew, and Calvin series) are on the sides of the steep ridges. Shallow, shaly Eutrochrepts (Dandridge and Whitesburg series) are on the shale formation that extends along the eastern side of the area. Hapludolls (Huntington and Staser series) and Eutrochrepts (Chagrin, Hamblen, Lobdell, Sullivan, and Lindsie series) occupy the narrow strips of bottom land. The proportion of poorly drained soils, mainly Aquepts and Aquults, is very small.

Potential natural vegetation: This area supports hardwood or mixed hardwood-pine forest vegetation. The deeper soils support good oak-hickory stands. The shallower soils, mostly on southern and western slopes, support pine or oak-pine types. Understory vegetation is also reflected by aspect. Little bluestem is the dominant grass species.

129—Sand Mountain

Alabama and Georgia
17,540 km² (6,770 mi²)

Land use: This area is about 70 percent woodland, 18

percent cropland, and 9 percent pastureland. About 3 percent is used for coal mining, urban development, or other purposes. About 83 to 88 percent of the woodland is privately owned, 10 to 15 percent industry owned, and about 2 percent federally owned. Timber production is mostly in the southern half of the area. Poultry production is the major farm enterprise. Corn, cotton, and vegetables are the major cash crops. Controlling erosion on soils that are cropped is the primary concern of management. Pastures are grazed mainly by beef cattle and are important disposal areas for poultry wastes.

Elevation and topography: Elevation ranges from 100 to 400 m, but a few mountaintops are as high as 500 m. The area is deeply dissected and consists mainly of a series of rather narrow valleys, steep escarpments, and broad plateaus that are underlain by sandstone and shale. Valley floors are commonly about 100 m below adjacent plateau summits.

Climate: *Average annual precipitation*—1,300 to 1,400 mm. Precipitation is somewhat unevenly distributed. The maximum is in midwinter, decreasing gradually from spring to autumn and increasing slightly in midsummer. *Average annual temperature*—16 to 17°C. *Average freeze-free period*—Mainly 200 to 210 days but ranges to 240 days in some valleys.

Water: In most years, precipitation is adequate for crops and pastures. Droughts are short and infrequent. Streams, springs, and ponds provide water for livestock. Deep wells provide an adequate supply of water for most domestic and municipal uses. Most streams flow intermittently and are often dry in summer and in autumn except after rainstorms. A few large reservoirs are in the area.

Soils: The dominant soils are Udults and Ochrepts. They have an udic moisture regime, a thermic temperature regime, and mixed mineralogy. They are over sandstone and shale and are mostly moderately fine textured to fine textured. Moderately deep, nearly level to steep Hapludults (Hartsells, Linker, and Townley series) are on broad plateaus, ridgetops, mountaintops, or upper side slopes. Deep Hapludults (Enders series) and Fragiudults (Wynntown series) are on some of the more level upland sites. Shallow, gravelly and very gravelly, nearly level to steep Dystrochrepts (Hector and Montevallo series) are on narrow upper valley slopes and ridgetops. Areas of rock outcrop are common on these sites. Deep Hapludults (Albertville series) and Paleudults (Allen series) are on lower side slopes and terraces.

Potential natural vegetation: This area supports mixed oak-pine forest vegetation. Shortleaf pine, loblolly pine, sweetgum, yellow-poplar, red oaks, and white oaks are the major overstory species. Dogwood and redbud are major midstory species. Japanese honeysuckle, greenbrier, low panicums, bluestems, and native lespedezas are understory species.

130—Blue Ridge

Georgia, Maryland, North Carolina, Pennsylvania, Tennessee, and Virginia
47,030 km² (18,160 mi²)

Land use: Two-thirds or more of the area is forested.

About a fifth of the area consists of national parks and forests. The acreage of parkland and forests is much higher in Georgia and in Tennessee. Parts of the area are popular resort and recreation sites. About one-tenth of the area is cropland, mainly on small farms in valleys and coves, and one-sixth is pasture. Corn and hay are the chief crops, but small grains, potatoes, and many kinds of fruits and vegetables are also grown. Tobacco is an important crop in some places. Most of the farms are part-time enterprises, and the occupants earn a large part of their livelihood elsewhere.

Elevation and topography: Elevation ranges from 300 m in the lower valleys and on foot slopes to more than 2,000 m in the mountains along the Tennessee-North Carolina boundary, decreasing gradually both north and south from this high point. The rugged mountains have steep slopes, sharp crests, and narrow valleys. Stream dissection is deep and intricate. Major streams and their tributaries flow through gorges and gaps of the mountains. Broad valleys and basins with rolling hills are extensive throughout the area. Local relief is 100 to more than 1,000 m.

Climate: *Average annual precipitation*—Mainly 1,025 to 1,275 mm but as much as 2,025 mm on the highest peaks in the south. Precipitation is somewhat unevenly distributed. The maximum is in midsummer and in midwinter and the minimum in autumn. Precipitation is 900 to 1,025 mm in the Asheville basin and in similar protected areas. *Average annual temperature*—10 to 16°C. *Average freeze-free period*—150 to 220 days, decreasing with increasing elevation and from south to north. It is sharply reduced on elevated peaks.

Water: Springs and shallow wells provide domestic water, but the ground water yield from wells is generally small. Water for livestock comes largely from springs and perennial streams, though some farm ponds have been built recently. In the southern two-thirds of the area, the major rivers have many dams that are used for flood control, electric power production, and recreation.

Soils: The dominant soils are Ochrepts and Udults. They are moderately deep and deep and medium textured. These soils have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Dystrochrepts (Ashe, Ditney, Sylico, Brookshire, Ranger, and Ramsey series) and Hapludults (Edneyville and Saluda series) are the principal soils on steep slopes of lower mountains. Hapludults (Fannin, Evard, and Porters series) are on the rolling foothills. Hapludults (Tusquittee series) and Haplumbrepts (Spivey series) formed from colluvium on foot slopes and coves. Boulders and outcrops of bedrock are conspicuous but inextensive on mountain slopes. Haplumbrepts (Burton series) are dominant at higher elevations. In the broad valleys, extensive Hapludults (Brevard, Fannin, Hayesville, Clifton, and Saluda series) are associated with Rhodudults (Rabun and Dyke series) over mafic rocks on rolling hills. Dystrochrepts (Comus and Codorus series) along the many narrow streams are frequently flooded unless protected.

Potential natural vegetation: This area supports Appalachian oak forest vegetation. White pine-hemlock, chestnut oak, white oak-red oak-hickory, northern red oak-basswood-white ash, yellow-poplar-white oak-northern red oak, and loblolly pine-shortleaf pine are important cover types. Dogwood, hornbeam, pawpaw, sassafras, persimmon, greenbrier, leatherwood, mountain-laurel, rhododendron, and witchhazel are included in the understory vegetation. Red spruce and balsam fir grow at higher elevations.

O—MISSISSIPPI DELTA COTTON AND FEED GRAINS REGION

116,080 km² (44,820 mi²)

This region consists of flood plains and low terraces of the Mississippi River south of its confluence with the Ohio River. The average annual precipitation ranges from 1,150 to 1,650 mm. The average annual temperature ranges from 14 to 21°C. The freeze-free period ranges from 200 to 340 days, increasing in length from north to south.

Aquepts, Aqualfs, Aquents, Udolls, and Udalfs are extensive. Many of the soils require drainage if they are used for crops.

Most of the soils throughout the region are poorly drained. If artificially drained, they are highly productive for many crops. Soybeans, cotton, corn, and hay are grown throughout the region. Rice in Arkansas and Louisiana and sugarcane in Louisiana are important crops locally. The wettest areas that are not artificially drained remain in forests, which are important for hardwood timber production and wildlife habitat.

131—Southern Mississippi Valley Alluvium

Arkansas, Mississippi, Missouri, and Tennessee
93,600 km² (36,140 mi²)

Land use: Most of this area is in farms. About 55 percent is cropland, 35 percent woodland, and 7 percent pasture. About 3 percent is used for miscellaneous purposes. Cropland makes up about three-fourths of the acreage in the north and less than one-fourth in the south. The proportion of forest land varies inversely with that planted to crops; the proportion of pasture is a little higher in the south. This is an important cash-crop area. Soybeans, cotton, and wheat grown by highly mechanized methods are the major crops throughout the area. Corn is an important crop in Missouri. Rice is an important crop in Arkansas, Louisiana, and Mississippi, and sugarcane is important in southern Louisiana. Controlling surface water and artificially draining the wet soils are major concerns of management.

Elevation and topography: Elevation is at sea level in the south and increases gradually to about 200 m in the north. The area consists of level to gently sloping broad flood plains and low terraces. Most of the area is flat. The only noticeable slopes are sharp terrace scarps and natural levees that rise sharply to several meters above adjacent bottom lands or stream channels. Swamps are significant in the extreme southern part in Louisiana.

Climate: *Average annual precipitation*—1,150 to 1,650 mm, increasing from north to south. In most of the area maximum precipitation is in winter and early in spring, decreasing gradually to a minimum in autumn. Along the Gulf Coast, maximum precipitation is in midsummer and early in autumn. Snowfall is negligible. *Average annual temperature*—14 to 21°C, increasing from north to south. *Average freeze-free*

period—200 to 340 days, increasing from north to south.

Water: Precipitation, streamflow, and aquifers supply moderate to large quantities of potable ground water. The Mississippi River crosses the area from north to south, and many of its tributaries also cross the area. Oxbow lakes and bayous are extensive throughout. Potable ground water is not available in extreme southern Louisiana.

Soils: The dominant soils are Aquepts, Aqualfs, Aquents, Udolls, and Udalfs. They are deep, medium textured and fine textured soils that have an udic or aquic moisture regime, a thermic temperature regime, and mostly montmorillonitic or mixed mineralogy. Fine textured Haplaquepts (Alligator, Perry, Portland, Sharkey, and Tunica series), Hapludolls (Desha, Bowdre series), and Ochraqualfs (Jackport series), and medium textured Fluvaquents (Commerce, Mhoon, and Convent series), Natraqualfs (Foley series), Ochraqualfs (Dundee, Amagon, and Hebert series), and Hapludalfs (Dubbs, Bosket, and Rilla series) occupy backswamp areas and older natural levees. Minor soils include moderately coarse textured Dystrochrepts (Beulah series) and Udifluvents (Robinsonville series), medium textured Fluvaquents (Gideon series), fine textured Hydraquents (Barbary series), and organic Medisaprists (Maurepas series). The Hydraquents and Medisaprists are in the extreme southern part in Louisiana.

Potential natural vegetation: This area supports deciduous bottom land forest vegetation. Willow oak, water oak, Nuttall oak, swamp white oak, sweetgum, water tupelo, baldcypress, native pecans, and hickories are the principal species. Black willow, eastern cottonwood, sycamore, sugarberry, and green ash are dominant on the more recent soils. Switchgrass, eastern gamagrass, little bluestem, indiangrass, Florida paspalum, plumegrass, sedges, and rushes are the dominant understory species.

P—SOUTH ATLANTIC AND GULF SLOPE CASH CROPS, FOREST, AND LIVESTOCK REGION

688,050 km² (265,660 mi²)

This region consists of the gently sloping to rolling southern Piedmont and upper Coastal Plain. The average annual precipitation ranges from 1,025 to 1,525 mm. Precipitation is considerably higher in midsummer than in the rest of the year. The average annual temperature is 16 to 20°C in most of the region but is as low as 14°C in some of the higher parts and as high as 21°C in the extreme southeast. The freeze-free period is 200 days or more in most of the region but is as long as 290 days in the southernmost part.

Udults are the dominant soils. Udalfs are less extensive in places where texture is clayey or the soils are on erosional surfaces. Ochrepts and Udalfs, which formed in limy materials, occur in parts of the region. Aquents, Fluvents, and Ochrepts are on flood plains and on low terraces.

Forests are important throughout this region and are the major land use in most areas. Cotton, soybeans, small grains, and corn are the main crops grown. Tobacco and peanuts are important locally. Pastures are also important and in some places are the main land use. Dairying is an important enterprise locally.

133A—Southern Coastal Plain

Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia
285,050 km² (110,060 mi²)

Land use: This area is about 69 percent woodland, 17 percent cropland, and 11 percent pastureland. About 3 percent of the area is used for rangeland, urban development, or other purposes. The woodland is 65 to 75 percent privately owned and 25 to 35 percent industry owned. A small percentage is federally owned. Timber production is important. Cash crops include soybeans, corn, peanuts, and cotton. Major vegetable crops, melons, tobacco, and pecans are important in some parts. Recently, livestock farming has increased. Pastures are used mostly for beef cattle, but some dairy cattle and hogs are raised. Controlling soil erosion and improving drainage on low wetland areas are major concerns of management.

Elevation and topography: Elevation ranges from 25 to 200 m, increasing gradually from the lower Coastal Plain northward. The area is strongly dissected into nearly level and gently undulating valleys and gently sloping to steep uplands that are underlain by unconsolidated sand, silt, and clay. Stream valleys generally are narrow in their upper reaches but become broad and have widely meandering stream channels as they approach the coast. Local relief is mainly a few meters, but in some of the more deeply dissected areas relief is 25 to 50 m.

Climate: *Average annual precipitation*—1,025 mm in the north to 1,525 mm in the south. Minimum precipitation is in autumn throughout the area. In the east maximum precipitation is in midsummer, and in the west it is in winter and in spring. *Average annual temperature*—16 to 20°C, increasing from north to south. *Average freeze-free period*—200 to 280 days, increasing from north to south.

Water: Precipitation, perennial streams, and ground

water provide an abundance of water. Domestic water supplies are obtained mainly from shallow wells and water for livestock from perennial streams and small farm ponds. In most places, one or more aquifers provide ample ground water for municipal and industrial uses. The many perennial streams have the potential for supplying water for municipal use, human consumption, and farming but have been little used for these purposes. A few large reservoirs are available for recreation and other uses.

Soils: The dominant soils are Udults. They are deep and have a thermic temperature regime, an udic moisture regime, a loamy or sandy surface layer, and a loamy or clayey subsoil. Well drained and moderately well drained, nearly level to strongly sloping Paleudults (Bama, Bowie, Dothan, Malbis, Norfolk, Orangeburg, Red Bay and Ruston series) are on uplands. Well drained gently sloping to steep Hapludults (Cahaba, Cuthbert, Kirvin, Luverne, Saffell, and Sweatman in the south and Suffolk, Emporia, Rumford, Kenansville, and Craven in the north) are on uplands. Associated with these soils in less sloping areas are the moderately well drained and somewhat poorly drained, loamy Fragiudults (Ora, Bourne, Pheba, and Savannah series), Fragiudalfs (Dulac and Providence series), Paleudults (Clarendon and Goldsboro series) and the well drained to moderately well drained, clayey Paleudults (Angie, Faceville, Greenville, Marlboro, and Shubuta series). Other well drained, nearly level to steep Paleudults (Darco, Fuquay, Lucy, Troup, and Wagram series), which have a thick sandy surface layer, are on uplands. Less extensive but locally important soils are the nearly level to moderately steep Quartzipsamments (Alaga, Kershaw, and Lakeland series) on uplands (mostly in the south), Paleudalfs (Atwood, Boswell, Millwood, and Susquehanna series) and Glossaqualfs (Aldine, Caddo, Guyton, Mollville, Waller, and Wrightsville series) (in the southwest), Paleudalfs

(Lexington series) on some loess-capped hilltops in the north-central part of the area, and nearly level Ochraquults (Amy, Myatt, Rembert, and Weston series), Albaquults (Cantey and Leaf series), and Paleaquults (Byars, Coxville, Pantego, and Plummer series) on low wetland. Bottom land soils include Udifluvents (Colling, Iuka, and Ochlockonee series), Fluvaquents (Bibb, Falaya, Mantachie, and Waverly series), and Dystrochrepts (Chenneby and Ouchita series).

Potential natural vegetation: This area supports mixed oak-pine forest vegetation. Loblolly, longleaf, slash, and shortleaf pines; sweetgum; yellow-poplar; and red and white oaks are major overstory species. Dogwood, gallberry, and farkleberry are major understory species. Common sweetleaf, American holly, greenbrier, southern bayberry, little bluestem, Elliott bluestem, threeawn, grassleaf goldaster, native lespedezas, and low panicums are other understory species.

133B—Western Coastal Plain

Arkansas, Louisiana, Oklahoma, and Texas

140,640 km² (54,300 mi²)

Land use: Most of this area is in farms. Between one-half and three-fourths is forest and woodland. A few large tracts are owned by large corporations and the federal government (national forests), and lumber and pulp wood production is important. Land that is cleared is used mostly for pasture and hay crops. About one-sixth is used for cropland. Common crops grown are corn, grain sorghum, oats, soybeans, peanuts, rice, and vegetable crops.

Elevation and topography: Elevation ranges from 25 to 200 m, increasing from south to north. This area is a gently to strongly sloping dissected coastal plain. Local relief is in meters.

Climate: *Average annual precipitation*—1,025 to 1,350 mm, increasing from northwest to southeast. Maximum precipitation is in spring and early in summer, and the minimum is late in summer and in autumn. *Average annual temperature*—16 to 20°C. *Average freeze-free period*—200 to 270 days, increasing from north to south.

Water: Precipitation, perennial streams, and ground water generally provide an abundance of water. Even though summer rainfall is generally adequate, droughts are common. There is a summer moisture deficit of 50 to 150 mm. The wet soils need to be drained before they can be used for crops. A few large reservoirs on major streams provide municipal water supplies and also serve as recreation sites. Water for farm use comes from ponds and wells.

Soils: Most of the soils are Udupts. They are deep, moderately coarse textured and coarse textured. These soils have a moderately coarse textured to fine textured subsoil, a thermic temperature regime, an

udic moisture regime, and siliceous or mixed mineralogy. Moderately well drained Paleudults (Bowie, Felder and Malbis series), well drained Paleudults (Briley, Lilbert, Darco, Ruston, Shubuta, and Smithdale series), well drained Hapludults (Kirvin and Cuthbert series), moderately well drained Hapludults (Sacul series), moderately well drained Hapludalfs (Woodtell and Cadeville series), well drained Paleudalfs (Nacogdoches and Bernow series), well drained Hapludalfs (Kisatchie series), somewhat poorly drained Albaqualfs (Anacoco series), and somewhat excessively drained Paleudults (Eustis series) are on uplands. Fluvaquents (Mantachie, Boggy, and Nahatche series), Udifluvents (Iuka, Oklared, and Severn series), Eutrochrepts (Marietta and Redlake series), and Glossaqualfs (Guyton series) are along major streams that drain the area. Most of the soils are weathered from sandstone and shale.

Potential natural vegetation: This area supports pine-hardwood forest vegetation. Loblolly pine and shortleaf pine grow with sweetgum, southern red oak, white oak, flowering dogwood, and post oak. American beautyberry, greenbrier, hawthorns, berry vines, and others make up the woody understory. Little bluestem and pinhole bluestem are the dominant herbaceous species. Other major grasses include beaked panicum, longleaf uniola, spike uniola, and yellow indiangrass. Many species of low-growing panicums and paspalums and perennial forbs such as tickclovers, lespedezas, wildbean, and several composites contribute significantly to the total annual yield.

134—Southern Mississippi Valley Silty Uplands

Arkansas, Kentucky, Louisiana, Mississippi, and Tennessee

51,410 km² (19,850 mi²)

Land use: Most of this area is in farms; a small acreage is federally owned. About 35 percent of the area is cropland, but the proportion varies greatly from county to county, depending on the soils and the topography. This is largely a cash-crop area. Cotton, corn, soybeans, and wheat are major crops, but rice is important locally in Arkansas and in Louisiana, and strawberries are important in Louisiana. Feed grains and forage are grown on dairy farms. About 16 percent of the area is in pasture or hay. About 46 percent is in forest of mixed pine and hardwoods. Lumber is the major forest product, and some pulpwood is harvested. The present trend is toward the conversion of the pasture and forest to cropland. About 3 percent of the area is used for urban development or other purposes. There is an increase in urban development near the metropolitan areas.

Elevation and topography: Elevation ranges from 25 to 100 m. The sharply dissected plains have a thick loess mantle that is underlain by unconsolidated

sand, silt, and clay, mainly of marine origin. Valley sides are hilly to steep, especially in the west. The intervening ridges are mostly narrow and rolling, but some of the interfluvies between the upper reaches of the valleys are broad and flat. Stream valleys are narrow in the upper reaches but broaden rapidly downstream and have wide, flat flood plains and meandering stream channels. Local relief is mainly several meters to 25 or 50 m.

Climate: *Average annual precipitation*—1,150 to 1,525 mm, increasing from north to south. Maximum precipitation is in winter and in spring, decreasing gradually through summer to autumn except for a moderate increase in midsummer. *Average annual temperature*—16 to 20°C, increasing from north to south. *Average freeze-free period*—200 to 280 days, increasing from north to south.

Water: Precipitation and ground water are abundant. On the uplands shallow wells, cisterns, ponds and rural water systems are the main sources of water for domestic use and livestock. Shallow wells provide small quantities of water, but deep wells in underlying sand and gravel yield large quantities. Most streams are small and flow intermittently. They flow most of the time in winter and in spring but only during and immediately after storms in summer and in autumn.

Soils: Most of the soils are Udalfs. They are deep, medium textured soils that have a thermic temperature regime, an udic moisture regime, and mixed mineralogy. Well drained, nearly level to very steep Hapludalfs (Memphis series) are on uplands. Moderately well drained, nearly level to strongly sloping Fragiudalfs (Grenada and Loring series) are on ridgetops, side slopes, and terraces. Somewhat poorly drained Fragiudalfs (Calloway series) and poorly drained Udifluvents (Morganfield and Vicksburg series), moderately well drained Udifluvents (Adler and Collins series), and somewhat poorly drained Fluvaquents (Falaya series) are on flood plains. In the east where the loess mantle thins, well drained Paleudalfs (Lexington series), moderately well drained Fragiudalfs (Dulac and Providence series), well drained Hapludults (Brandon and Silerton series), and well drained Paleudults (Smithdale series), all of which are gently sloping to steep, are on ridgetops and side slopes. Well drained Dystrochrepts (Ariel series), moderately well drained Udifluvents (Collins series), moderately well drained Dystrochrepts (Oaklimer series), and somewhat poorly drained Fluvaquents (Falaya and Gillsburg series) are on the flood plains.

Potential natural vegetation: This area supports hardwood and pine forest vegetation. Cherrybark oak and Shumard oak are widely distributed. Yellow-poplar, white ash, cottonwood, and black walnut are important species on the flood plains. Loblolly and shortleaf pines are on a wide variety of sites, mainly

the eroded soils of the uplands and ridges. Other hardwood species that commonly grow in this area are white oak, basswood, sweetgum, water oak, American elm, blackgum, sycamore, sassafras, southern red oak, chinkapin oak, American beech, and hickory.

135—Alabama, Mississippi, and Arkansas Blackland Prairie

Alabama, Arkansas, and Mississippi
21,550 km² (8,320 mi²)

Land use: In Alabama and Mississippi, this area is about 58 percent woodland, 26 percent pastureland, and 14 percent cropland. The small outlier in Arkansas is about 40 percent pastureland, 33 percent woodland, and 25 percent cropland. Most soil areas have been disturbed, and only small remnants of the former prairie vegetation remain. About 2 percent of the area is used for urban development or for other purposes. Soybeans are the major crop, but corn, small grains, and cotton are also grown. Pastures are used mainly for beef production, but in some places dairying is an important industry. The woodland is about 75 to 80 percent privately owned, and about 20 to 25 percent is owned by industry. This is not a very productive woodland area. Controlling soil erosion and infestation of Johnsongrass on soils that are cultivated are major concerns of management.

Elevation and topography: Elevation ranges from 25 to 100 m. Some of the more prominent valley floors are less than 25 m, and a few ridgetops exceed 100 m. Valley floors, side slopes, and ridgetops are underlain by clay, marl, and chalk. Local relief is mainly a few meters.

Climate: *Average annual precipitation*—1,225 to 1,425 mm. Maximum precipitation is early in winter, in spring, and in midsummer; the minimum is in autumn. *Average annual temperature*—16 to 18°C, decreasing from south to north. *Average freeze-free period*—220 to 260 days.

Water: Precipitation and perennial streams are important sources of water, but ground water from moderately deep and deep wells is the principal source for both domestic and municipal uses. Ponds provide water for livestock, and locally they are used for recreation. A few large reservoirs are available for recreation and other uses.

Soils: The dominant soils are Ochrepts and Udalfs. They are fine textured and have a thermic temperature regime, an udic moisture regime, and montmorillonitic or carbonatic mineralogy. They are mainly moderately deep to deep over soft limestone or chalk and typically shrink, swell, and crack. Well drained Eutrochrepts (Sumter series) and moderately well drained to poorly drained Hapludalfs (Oktibbeha and Vaiden series), all of which are nearly level to gently sloping and strongly sloping, are on wide ridgetops

and narrow side slopes. Shallow Udorthents (Demopolis series) occur locally but are of small extent. Moderately well drained to poorly drained, nearly level to gently sloping Haplaquepts (Leeper series) and Chromuderts (Terouge series), Hapludolls (Catalpa series), and Pelluderts (Eutaw and Trinity series) are on bottom land and in low upland areas. The outer perimeter of the area is intermittently ringed with moderately well drained to somewhat poorly drained Paleudalfs (Boswell and Susquehanna series) and moderately well drained and well drained Hapludults (Saucul and Saffell series).

Potential natural vegetation: This area supports deciduous hardwood forest vegetation. Red oak, white oak, sweetgum, and blackgum are the dominant overstory species. Eastern redcedar, dogwood, and osage orange are major midstory species. Japanese honeysuckle, greenbrier, little bluestem, native lespedezas, plumegrass, low panicums, sedges, and rushes are the dominant understory species.

136—Southern Piedmont

Alabama, Georgia, North Carolina, South Carolina, and Virginia
161,430 km² (62,330 mi²)

Land use: Most of this area is in small farms, but a sizable acreage is controlled by woodland companies. Land adjacent to major cities is used for residences and associated urban development. Although most of the land was once cultivated, much has reverted to mixed stands of pine and hardwoods. Most of the open land is pasture, but some crops, such as soybeans, small grain, corn, cotton, wheat, and, to a lesser extent, tobacco, are grown. Dairy cattle and poultry are important locally.

Elevation and topography: Elevation ranges from 100 to 400 m. Drainage patterns are well defined. Streams have dissected the original plateau, leaving narrow to fairly broad upland ridgetops and short slopes adjacent to the major streams. The valley floors generally are narrow and make up about 10 percent or less of the land area. The associated stream terraces are minor.

Climate: *Average annual precipitation*—1,150 to 1,400 mm. Precipitation is evenly distributed throughout the year, but the lowest is in autumn; snowfall is light. *Average annual temperature*—14 to 18°C. *Average freeze-free period*—205 to 235 days.

Water: Precipitation, perennial streams, and lakes provide an abundance of water. Ground-water supplies are relatively small, but shallow and deep wells are the principal sources of water for domestic use. Small farm ponds are an important source of water for livestock.

Soil: The dominant soils are Udults. They have a clayey or loamy subsoil, a thermic temperature regime, an udic moisture regime, and kaolinitic, mixed, or oxidic mineralogy. Well drained very gently slop-

ing to gently sloping Hapludults (Cecil, Madison, and Appling series) and Paleudults (Davidson series) are on uplands. Well drained Hapludults, Rhodudults, Dystrochrepts, and Hapludalfs (Pacolet, Cecil, Gwinnett, Louisa, Louisburg, and Wilkes series) are on the steeper slopes. In some localities, these soils contain coarse fragments. Dystrochrepts (Chewacla series), Udifluvents (Congaree and Cartecay series), and Fluvaquents (Wehadkee series) are in alluvial deposits.

Potential natural vegetation: The uplands generally support hardwood and pine forest vegetation. Loblolly pine, slash pine, white oak, red oak, gum, yellow-poplar, and sycamore are principal species; pine is dominant on eroded sites. Hardwoods or mixed stands of pine and hardwoods are on slightly eroded soils and stream flood plains. Dogwood, honeysuckle, pinehill bluestem, briars, and other grasses and forbs characterize the understory.

137—Carolina and Georgia Sand Hills

Georgia, North Carolina, and South Carolina
22,680 km² (8,760 mi²)

Land use: Most of this area is in farms; about one-sixth is federally owned and used for military posts and as training areas. Small acreages are used for urban development or for other purposes. About 80 percent is forest of pine and scrub oaks. Pulpwood and some lumber are the principal forest products. About 15 percent of the area is cropland, and about 5 percent is pasture. Corn and cotton are the principal crops. Most of the farms are part-time or subsistence farms.

Elevation and topography: Elevation ranges from 50 to 200 m, increasing gradually from south to north. The area is a dissected rolling to hilly upland. In many of the more dissected sites, there are stabilized dunes, resulting in very irregular slopes. Local relief is mainly several meters, but a few hills are 25 to 50 m above adjacent areas.

Climate: *Average annual precipitation*—1,150 to 1,275 mm. Maximum precipitation is in midsummer, and the minimum is in autumn. *Average annual temperature*—17 to 18°C. *Average freeze-free period*—220 to 240 days.

Water: Precipitation, perennial streams, and ground water supply an abundance of water. The kind and amount of plant growth is severely limited by low moisture in the rapidly permeable soils that are dominant in this area.

Soils: The dominant soils are Psammments and Udults. They have a thermic temperature regime and an udic moisture regime. Deep, sandy Quartzipsammments (Lakeland and Kershaw series) and Paleudults (Blanton and Troup series) are on rolling to hilly slopes where the upper sandy strata are thick. Fragiudults (Blaney and Vacluse series), Paleudults (Dothan and Fuquay series), and Hapludults (Pelion series) occur where

the upper sand strata are thinner and underlain by more clayey materials. Psammaquents (Osier series) and Humaquepts (Rutlege series) are on very poorly drained sites along drainageways.

Potential natural vegetation: This area supports pine-oak forest vegetation. Longleaf pine is the dominant species. Turkey, blackjack, bluejack, and sand live oaks are included. Little bluestem, panicums, pineland threeawn, and associated grasses and forbs make up the ground cover vegetation.

138—North-Central Florida Ridge

Florida

3,400 km² (1,310 mi²)

Land use: Most of this area is in farms, but some large holdings are used exclusively for forestry. Pasture makes up about one-fourth of the area; the remainder is mainly cropland. Corn, peanuts, tobacco, soybeans, vegetables, and melons are major crops. Some hay and feed grains are grown for livestock. More than one-half of the area is forested. Pulpwood and lumber are the principal forest products.

Elevation and topography: Elevation ranges from 25 to 50 m. The sand-mantled limestone upland has an irregular, gently rolling topography. Many limestone sinks, some filled with water, dot the area. There are a few streams. Local relief is a few meters to about 10 m.

Climate: *Average annual precipitation—1,300 to 1,400 mm. Maximum precipitation is in summer, and the minimum is in winter and late in autumn. Average annual temperature—20 to 21°C. Average freeze-free period—280 to 290 days.*

Water: The abundant rainfall and ground water are the principal sources of water. Shallow and deep wells provide water for domestic use, for livestock, and for irrigation. The many lakes and ponds are used for recreation.

Soil: The dominant soils are Udults and Psammments. They have a thermic temperature regime and an udic moisture regime. Well drained and somewhat poorly drained Paleudults (Blanton and Albany series) have thick sandy layers over a loamy subsoil. Excessively drained and moderately well drained Quartzipsammments (Alpin and Chipley series) are sandy throughout. Well drained, sandy Hapludalfs (Archer series), which have a clayey subsoil, and poorly drained sandy Haplaquods (Mascotte and Leon series), which have a weakly cemented layer, are less extensive.

Potential natural vegetation: This area supports open pine and oak forest vegetation. Longleaf pine and turkey oak are dominant trees. Several bluestem species, indiagrass, and several threeawn species are the dominant ground cover. Hairy panicum and many sedges are scattered throughout the area. Legumes and many annual forbs are in this area.

R—NORTHEASTERN FORAGE AND FOREST REGION

314,540 km² (121,440 mi²)

This cool, humid region consists of plateaus, plains, and mountains. The average annual precipitation ranges from 750 to 1,325 mm. In most of the region more than one-half of the precipitation falls during the freeze-free season. The average annual temperature is 3 to 11°C. The freeze-free period generally is 110 to 160 days but ranges from 80 days in the higher mountains to as long as 200 days in some areas along the Atlantic coast.

Ochrepts and Orthods are the dominant soils. They commonly have a fragipan. Udalfs formed in limy parent material. They also have a fragipan but are less extensive than the Ochrepts and Orthods. Aqualfs, Aquepts, and Histosols occur in the lowlands and in depressions. Fluvents on flood plains are of small extent but are important for many uses. Stoniness and steep slopes are limitations to use of many of the soils.

Most of the land in this region, especially the steeper areas, is forested. Significant amounts of lumber and pulpwood are produced. Locally, Christmas trees and maple syrup are important forest products. Forage and grains for dairy cattle are the principal crops. In places where markets, climate, and soils are favorable, fruits, tobacco, potatoes, and vegetables are important crops. Wildlife habitat and recreation are important land uses.

139—Eastern Ohio Till Plain

Ohio and Pennsylvania

15,030 km² (5,800 mi²)

Land use: About three-fourths of the area is in farms, one-fifth is urbanized, and the remainder is used for other purposes. About one-third is cropland. Feed grains and forage for dairy cattle are the main crops in the west. Similar crops are grown in the east, where there are many part-time farms and many rural residences. Slightly more than 10 percent is pasture. About one-fifth is hardwood forest, mainly in farm woodlots. Some large holdings are used for watershed protection.

Elevation and topography: Elevation ranges from 200 to 300 m, increasing gradually from north to south. The gently to strongly rolling dissected glaciated plateau is underlain mostly by sandstone and siltstone. Stream valleys are narrow and are not deeply incised. In places, the interfluves are broad and nearly level. Local relief is about 2 to 15 m.

Climate: *Average annual precipitation*—900 to 1,025 mm. Precipitation is fairly evenly distributed throughout the year, but it is slightly higher in spring and early in summer and lowest in winter. Precipitation in winter is mostly snow. *Average annual temperature*—About 10°C. *Average freeze-free period*—About 160 days.

Water: Precipitation, perennial streams, and ground water provide an abundance of water. Shallow and deep wells are the main sources of water for domestic use and municipal supplies. On many farms, small artificial ponds provide water for livestock and supplemental irrigation and are also used for recreation. Large reservoirs on perennial streams provide water for several of the large cities.

Soils: Most of the soils are Udalfs and Aqualfs. They have a mesic temperature regime, an udic or aquic moisture regime, and mixed or illitic mineralogy. They are medium textured to fine textured and

formed from glacial till. Included is a distinct, relatively small area of Udults in more acid till. Well drained and moderately well drained, gently sloping to moderately steep Fragiudalfs (Canfield, Rittman, and Wooster series) are on uplands. Somewhat poorly drained, gently sloping Ochraqualfs (Mahoning series) are on uplands. Poorly drained and somewhat poorly drained, nearly level to gently sloping Fragiaqualfs (Sheffield and Ravenna series) are on uplands. Well drained, gently sloping to moderately steep Fragiudults (Hanover series) are on uplands.

Potential natural vegetation: This area supports mostly beech forest vegetation. American beech, sugar maple, red oak, white ash, and white oak are the dominant species. American basswood, shagbark hickory, black cherry, and cucumbertree also are included. American beech and sugar maple are dominant on poorly drained local flatland. Mixed mesophytic oak-sugar maple and oak forest grows locally.

140—Glaciated Allegheny Plateau and Catskill Mountains

New Jersey, New York, Pennsylvania, and Ohio

70,540 km² (27,240 mi²)

Land use: Much of this area is in farms, but a large acreage is in second and third growth forests of oak and northern hardwoods. Urban use is expanding in some places. The Catskills are used mainly for recreation. Hay, pasture, and some grain for dairy cattle are the principal crops. Locally, potatoes are an important crop on the plateau tops, and poultry, fruits, and truck crops are produced in many of the narrow valleys. Abandoned or idle land common in the steeper areas is reverting to grasses, weeds, shrubs, and trees.

Elevation and topography: Elevation is 200 to 300 m on valley floors, 500 to 600 m at the plateau surface, and 1,100 m or more in parts of the Catskills. The top of the dissected plateau is broad and nearly

level to moderately sloping. The narrow valleys have steep walls and smooth floors. The Catskills in the east have steep slopes.

Climate: *Average annual precipitation*—750 to 1,025 mm. Precipitation is mostly snow. *Average annual temperature*—8 to 10°C. *Average freeze-free period*—110 to 160 days.

Water: Precipitation and perennial streams and lakes provide an abundance of water. The Finger Lakes are a conspicuous feature along the northern border. Soils that have a fragipan are too wet in winter and in spring and are deficient in moisture during much of the growing season.

Soils: Most of the soils are Ochrepts. They are moderately deep to deep, somewhat stony, and medium textured. These soils have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Nearly level to moderately sloping, moderately well drained Fragiocrepts (Mardin and Wellsboro series) and somewhat poorly drained Fragiocrepts (Volusia and Morris series) are on till-mantled uplands. Shallower and more stony Dystrocrepts (Lordstown and Oquaga series) are on steeper sites. Deep, well drained Dystrocrepts (Chenango series) are on outwash in the valleys. Dystrocrepts (Barbour series) and Eutrocrepts (Tioga and Chagrin series) are on the younger stream deposits of valley floors. Hapludalfs (Howard and Palmyra series) in limy outwash materials are conspicuous locally but of small extent.

Potential natural vegetation: This area supports forest vegetation, particularly hardwood species. Beech-birch-maple and elm-ash-red maple are potential forest types. Oak species increase from east to west, particularly in areas of shallow and dry soils. In places, conifers, such as white pine, are important. Aspen, hemlock, northern white-cedar, and black ash grow on the wetter soils. In some parts of the area, sugar maple has potential economic significance.

141—Tughill Plateau

New York
3,080 km² (1,190 mi²)

Land use: Most of this area is forested with mixed hardwoods and conifers. Part of the forested land is abandoned cropland that has reverted to forest vegetation. Pulpwood, saw logs, Christmas trees, and maple syrup are the principal forest products. Less than one tenth of the area is cropland. Forage and some feed grains grown for dairy cattle are the main crops. Sizable acreages have reverted to unproductive brush and weeds. Urbanization is insignificant in this area.

Elevation and topography: Elevation ranges from 300 m along the lower margins to 600 m at the plateau top. This plateau is underlain by sandstone. It is nearly level to gently sloping across the top, and hilly

to steep around the margins. Local relief is a few meters to about 25 m, but the bordering lowlands are about 100 m below the plateau top. Streams flow off the plateau in several directions.

Climate: *Average annual precipitation*—900 to 1,025 mm. Precipitation is evenly distributed throughout the year. Snowfall is heavy from late in autumn to early in spring. In some places, the total snowfall is as much as 355 cm. *Average annual temperature*—4 to 7°C. *Average freeze-free period*—110 to 135 days.

Water: Precipitation and perennial streams provide an abundance of water. Shallow and deep wells supply water for domestic use and for livestock. There are few natural ponds or lakes, but ground water is close to the surface in many areas. Dense fragipans in most of the soils perch ground water for extended periods during winter and spring. The water resources available are little used.

Soils: Most of the soils are Orthods or Aquods. They are deep, stony, and medium textured. These soils have a frigid temperature regime, an udic or aquic moisture regime, mixed mineralogy, and a fragipan. They formed in glacial till derived primarily from acid sandstone. Well drained and moderately well drained Fragiorthods (Worth and Empeyville series) are on undulating to moderately sloping landscapes. Associated in lower areas are nearly level to gently sloping, poorly drained Fragiocluvents (Westbury series). Very poorly drained Humaquepts (Tughill series) are extensive in flats and in depressions. A few large deeper and wetter depressions contain Borohemists (Rifle series). Haplorthods (Colosse and Adams series) in sandy outwash deposits are prominent locally but are of small extent.

Potential natural vegetation: This area supports northern hardwood forest vegetation. The beech-birch-sugar maple type is of primary importance. Sugar maple is of particular economic significance. The elm-ash-red maple type also has potential in some parts of the area. Red spruce, balsam fir, and white pine can be expected in mixed stands. Early succession vegetation includes high and low bush blueberry and aspen-birch forest types. As succession approaches climax, sugar maple, beech, and hemlock increase in importance. Eastern hemlock, white spruce, American elm, black ash, and red maple grow on the wetter soils. A moss-Labrador tea-fern vegetation grows on extremely wet, organic soils.

142—St. Lawrence-Champlain Plain

New York and Vermont
14,260 km² (5,510 mi²)

Land use: Most of this area is in farms or forests; only about 6 percent is used for urban development or for other purposes. About one-fourth is cropland, and less than one-tenth is pasture. Hay for dairy cattle is

the principal crop, but some small grain and corn are grown for silage. Potatoes are an important cash crop in some places, and a few apple orchards are on the slopes along Lake Champlain, but the total acreage of these crops is small. About one-half of the area is forested with northern hardwoods and conifers. Saw logs and pulpwood are the main forest products. Christmas trees and maple syrup are produced in some localities.

Elevation and topography: Elevation ranges from 25 to 300 m, increasing gradually from the St. Lawrence River southward and from Lake Champlain to the east and the west. Rivers and streams have cut relatively deep but narrow valleys across the nearly level to undulating marine and glacial plain. Local relief is usually only a few meters, but glacial till ridges, till plains, and some outwash terraces rise 5 to 25 m above the adjacent plain.

Climate: *Average annual precipitation*—About 900 mm. Precipitation is evenly distributed throughout the year. Snowfall is heavy from late in autumn to early in spring. *Average annual temperature*—4 to 7°C. *Average freeze-free period*—120 to 140 days but about 160 days in a narrow belt around Lake Champlain.

Water: Precipitation, numerous perennial streams, and ground water provide an abundance of water. Deep wells in the glacial drift yield moderate quantities of water. The ground water in areas underlain by limestone is highly mineralized. Nearly level areas, mainly of heavy textured marine and lake-laid sediments, have ground water close to the surface during part of the year. The St. Lawrence Seaway, which forms the northern border of the area, and Lake Champlain are important transportation arteries and are also used extensively for recreation.

Soils: The dominant soils are Aqualfs and Ochrepts. They are deep and fine textured and medium textured. These soils have a mesic temperature regime, an udic or aquic moisture regime, and illitic or mixed mineralogy. At the lowest elevations, nearly level, poorly drained and somewhat poorly drained Ochraqualfs (Covington and Kingsbury series) and poorly drained and very poorly drained Haplaquepts (Livingston series) are in clayey marine and lake-laid sediments. Some sizable areas of these heavy textured deposits have a thin sandy mantle, and poorly drained to somewhat poorly drained Haplaquepts (Swanton series) and moderately well drained Eutrochrepts (Elmwood series) occur in these areas. Associated on the same landscape are well drained and moderately well drained Eutrochrepts (Grenville and Hogansburg series) on low ridges of calcareous glacial till. The soils of the higher till plains grade from a mesic temperature regime to a frigid temperature regime, and the dominant ones are moderately well drained and well drained Fragiorthods (Empeyville and Worth series), well drained Dystrochrepts (Charlton series)

and somewhat poorly drained Fragiagquods (Westbury series). The glacial drift in these gently sloping to rolling areas is moderately stony and is derived mainly from acid sandstone. Well drained Haplorthods (Colton and Adams series) in sandy glacial outwash and aeolian deposits are also fairly extensive. Areas of rock outcrop are prominent features in the western part of the area.

Potential natural vegetation: This area supports hardwood forest vegetation. The beech-birch-sugar maple forest type is the dominant climax species. Basswood, American elm, maple species, white ash, black cherry, and white pine are included in this forest type. The aspen-birch type, earlier in succession, is economically important. Species such as eastern hemlock, red maple, American elm, and spruce have potential on wet soils.

143—Northeastern Mountains

Maine, Massachusetts, New Hampshire, New York, and Vermont
101,760 km² (39,290 mi²)

Land use: More than 90 percent of this area is forested with northern hardwoods, spruce, and fir. Wood for lumber and pulp for the paper industry are the principal products. Most of the remaining area consists of isolated farms or of small residential developments or is used for recreation. Much of the area of the Adirondacks in New York is in a state park. Although most of the area in New England is privately owned, some large acreages are in national forests, state forests, or state parks. This area is widely used for year-round recreation. Most farming is a part-time enterprise. Erosion on logging roads and ski trails is a potentially serious land use problem.

Elevation and topography: Elevation ranges from 300 to 1,200 m, but a few isolated peaks are more than 1,500 m, and some of the valleys, especially in northeastern Maine, are less than 300 m. The mountains and foothills are commonly rounded; are underlain by granite, anorthosite, gneiss, schist, and slate; and are thinly mantled by glacial till. Many glacially broadened valleys have glacial outwash deposits and contain numerous swamps and lakes. Mountain and foothill slopes are moderately steep to very steep, and valleys are nearly level to sloping.

Climate: *Average annual precipitation*—875 to 1,325 mm. More precipitation falls in summer than in winter. Heavy snowfalls are common in winter. *Average annual temperature*—3 to 7°C. *Average freeze-free period*—80 to 130 days.

Water: Precipitation, perennial streams, and lakes provide an abundance of water. Ground water is abundant in deep outwash in valleys but is scarce in the till and bedrock on the uplands.

Soils: Most of the soils are Orthods. They are stony and medium textured to coarse textured. These soils have a frigid temperature regime, an udic moisture

regime, and mixed mineralogy. Shallow, excessively drained to somewhat excessively drained Haplorthods (Woodstock, Canaan, Lyman, and Thorndike series) and moderately deep, well drained Haplorthods (Tunbridge series) are on steep and very steep bed-rock ridges. Deep, somewhat excessively drained to well drained, gently sloping to steep Haplorthods (Hermon series) and deep, well drained to somewhat poorly drained, gently sloping to steep Fragiorthods (Becket, Marlow, Plaisted, Stowe, Peru, and Howland series) are on glacial till ridges. Deep, excessively drained to well drained, gently sloping to steep, nonstony Haplorthods (Colton, Adams, Stetson, and Allagash series) are on outwash deposits in valleys. Deep, somewhat poorly drained, nearly level to gently sloping Fragiaquods (Westbury series), somewhat poorly drained to very poorly drained, nearly level to gently sloping Fragiaquepts (Cabot, Ridgebury, Monarda, and Peacham series), and very poorly drained, nearly level to gently sloping Histosols (Cathro, Togus, and Vassalboro series) are on lower glacial till slopes and in depressions.

Potential natural vegetation: This area supports northern hardwood and spruce-fir forest vegetation. Sugar maple, yellow birch, American beech, red spruce, and eastern hemlock are dominant on the better drained soils of the hills and ridges. Red spruce and balsam fir are dominant on the wetter soils of long, gentle slopes and in depressions. Stunted balsam fir and red spruce are common in some of the high mountaintop areas.

144A—New England and Eastern New York Upland, Southern Part

Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont
52,040 km² (20,090 mi²)

Land use: About three-fifths of this area is in hardwood and pine forests, most of which are in small holdings. Some are in state forests or in other large holdings. The woodland is used for growing wood products and for hunting and other recreation. Use of woodland for residential development is increasing. About one-sixth of the area is in crops and pasture; the acreage in crops is somewhat greater than that in pasture. Forage crops for dairy cattle are grown on most of the cropland. Truck crops, small fruits, and apples are grown on some farms, mainly near the larger towns and cities. Many farmsteads are used as rural residences, and the residents earn their living from nonfarm occupations. About one-eighth of the area is urbanized, and the acreage used for this purpose is increasing rapidly. Controlling sedimentation and erosion are concerns of management in areas where urban development is expanding.

Elevation and topography: Elevation ranges from sea level to 300 m in much of the area, but it is 600 m

on some hills. The till-mantled rolling to hilly uplands are broken by many level to gently sloping valleys that terminate in coastal lowlands. These valleys and coastal plains are covered by glaciolacustrine and marine sediments and outwash. Relief is mostly about 2 to 20 m in the valleys and about 25 to 100 m on the uplands.

Climate: *Average annual precipitation*—825 to 1,275 mm. Precipitation generally is evenly distributed throughout the year, but near the coast it is slightly lower in spring and in summer; inland it is slightly higher in spring and in summer. *Average annual temperature*—7 to 10°C, increasing from north to south. *Average freeze-free period*—120 to 200 days, increasing from north to south.

Water: Abundant precipitation, many perennial streams, and many natural lakes and ponds are important sources of water. Many large and small reservoirs provide municipal and industrial water. Ground water is scarce on the till-mantled uplands but is abundant in the deep outwash deposits in the valleys.

Soils: The dominant soils are Ochrepts. These soils are medium textured and moderately coarse textured and have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Deep Dystrochrepts (Charlton and Gloucester series), Fragiocchrepts (Paxton series), and shallow Dystrochrepts (Hollis series) are dominant on the till-mantled hills of New England. Occurring in the sandy glacial outwash are Udorthents (Hinckley series) and Udipsamments (Windsor series). On the uplands bordering the Hudson Valley of New York and the Vermont Valley and the Taconic Mountains of Vermont, Dystrochrepts (Dutchess and Nassau series) and Fragiocchrepts (Bernardston and Pittstown series) are dominant, along with smaller amounts of Eutrochrepts (Stockbridge, Nellis, and Farmington series). Fragiudults (Rockaway series) and Fragiocchrepts (Swartswood series) are dominant on the till-mantled uplands of northwestern New Jersey. Hapludalfs (Washington series) and Dystrochrepts (Riverhead series) are dominant in the valleys.

Potential natural vegetation: This area supports a mixture of northern and central hardwoods. Sugar maple, birch, and beech, as well as oaks and hickory, are major species. White pine and hemlock are the dominant conifers; pitch pine and red pine grow on sandy outwash soils. Red maple grows on the wetter sites. Northern white-cedar reaches its northern limit in bogs.

144B—New England and Eastern New York Upland, Northern Part

Maine, Massachusetts, New Hampshire, New York, and Vermont
48,570 km² (18,750 mi²)

Land use: About four-fifths of this area is in hardwood and conifer forests, most of which are in small

holdings. Some are in state forests or in other large holdings. Saw logs are the principal product, but maple syrup and Christmas trees are produced on some sites. The woodlands are widely used for hunting and other recreation. In some places, significant areas of forestland are used for residential and leisure home developments. About one-eighth of the area is in crops and pasture; the acreage of cropland is somewhat greater than that of pasture. Forage crops for dairy cattle are grown on most of the cropland. Truck crops, small fruits, and apples are grown on some farms, mainly near the larger towns and cities. Many farmsteads are used as rural residences, and the residents earn their living from nonfarm occupations. About 5 percent of the area is urbanized. Controlling sedimentation and erosion are concerns of management in areas where urban development is expanding.

Elevation and topography: Elevation ranges from sea level to 300 m in much of the area; however, it is 600 m on some hills and 900 m on a few isolated peaks. Till-mantled rolling to hilly uplands characterize most of the area. Level to gently sloping valleys terminating in coastal lowlands occur in Maine. These valleys and coastal plains are covered by glaciolacustrine and marine sediments and outwash. Relief is mostly about 2 to 20 m in the valleys and about 25 to 100 m on the uplands.

Climate: *Average annual precipitation*—900 to 1,225 mm. Precipitation generally is evenly distributed throughout the year, but near the coast it is slightly lower in spring and in summer; inland it is slightly higher in spring and in summer. Heavy snowfalls commonly occur late in winter. *Average annual temperature*—4 to 7°C. *Average freeze-free period*—110 to 160 days.

Water: Abundant precipitation, many perennial streams, and many natural lakes and ponds are important sources of water. Many large and small reservoirs provide municipal and industrial water. Ground water is scarce on the till-mantled uplands but is abundant in the deep outwash deposits in the valleys.

Soils: The dominant soils are Orthods. These soils are medium textured to coarse textured and have a frigid temperature regime, an udic moisture regime, and mixed mineralogy. Haplorthods are dominant on the higher hills that have a thin till mantle and on lower areas of sandy glacial outwash and till. Gently sloping to steep Fragiorthods are dominant on drumloidal landforms. The characteristic hardpan of the Fragiorthods is at a depth of 60 to 90 cm. Udifluvents on narrow flood plains and Eutrochrepts on marine and lacustrine sediments are inextensive but are important to agriculture.

Potential natural vegetation: This area supports northern hardwood forest vegetation. Beech, white and yellow birch, sugar maple, and hemlock are

dominant on the better drained soils. Spruce and balsam fir are dominant on the wetter soils and on mountain tops. The northern aspects of mountain slopes favor spruce and fir, and the southern aspects support northern hardwoods. White pine is common on abandoned farmland, in river valleys, and on outwash plains. Spruce-fir, mountain cranberry, and similar acid-tolerant plants grow on alpine to subalpine mountaintops.

145—Connecticut Valley

Connecticut, Massachusetts, New Hampshire, and Vermont
6,560 km² (2,530 mi²)

Land use: About 40 percent of this area, including small private woodlands, state forests, and reservoir watersheds, consists of hardwood and pine forests. The forested land is used for residential, recreational, wildlife, and esthetic purposes or it is held for investment. Lumbering is of minor importance. Locally, maple syrup and Christmas trees are important forest products. About 35 percent of the area is used for urban and other community developments. Expansion of industrial and commercial facilities is rapidly using up prime farmland. Many small tracts are used as rural residences by occupants who are employed in cities and towns. About 20 percent of the area is in farms, on which about 60 percent of the area is cleared and used for crops and pasture. Forage, tobacco, vegetables, fruits, potatoes, and nursery stock are major crops. Hay and silage corn for dairy cattle make up a substantial acreage on many farms. Poultry and greenhouse products are important locally.

Elevation and topography: Elevation ranges from sea level to 100 m in lowlands and from 200 to 300 m on ridges. Nearly level to sloping lowlands mantled by glaciolacustrine and marine sediments, glacial till, and outwash are broken by isolated north-south traprock ridges that have hilly and steep slopes. Local relief is 1 to 20 m on lowlands. The ridges are about 50 to 100 m above the lowlands.

Climate: *Average annual precipitation*—1,025 to 1,275 mm. Precipitation is evenly distributed throughout the year. Snowfall in winter averages 102 cm. *Average annual temperature*—7 to 11°C. *Average freeze-free period*—150 to 195 days.

Water: Precipitation, perennial streams, lakes, and ground water provide an abundance of water. Water for municipal and industrial needs is stored in reservoirs in this area and in adjoining areas. In some soils that have a fragipan, the water table is perched from late in fall to early in spring. Soils of wetlands are saturated during a large part of the year.

Soils: Most of the soils are Ochrepts. The soils are deep and loamy and have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Gently sloping to moderately steep, well drained Fragi ochrepts

(Wethersfield and Paxton series) and well drained Dystrochrepts (Cheshire and Charlton series) are on till-mantled lowlands. Shallow Dystrochrepts (Holyoke series) are on steeper slopes associated with traprock ridges. Deep, well drained Dystrochrepts (Hartford and Merrimac series), excessively drained Udipsamments (Windsor series), and excessively drained Udorthents (Manchester and Hinckley series) are on glacial outwash in the valleys. Deep, moderately well drained, nearly level Dystrochrepts (Berlin series) and Eutrochrepts (Buxton series) are on lacustrine sediments. Dystrochrepts (Hadley and Winooski series) and Fluvaquents (Limerick series) are on flood plains.

Potential natural vegetation: This area supports hardwood and pine forest vegetation. Oak, hickory, maple, beech, and birch species are dominant. Coniferous species, white pine, and eastern hemlock are more prevalent in the north than in the south. Red maple, black ash, American elm, and Atlantic white-cedar are common on the wetter soils.

146—Aroostook Area

Maine

2,700 km² (1,040 mi²)

Land use: About 60 percent of this area is cropland. Potatoes are the major crop, but oats, hay, peas, and buckwheat are grown in some places. Most of the remaining land is forested or is cropland reverting to forest. Forest products are used mainly in the paper industry and for lumber. Intensive cropping has resulted in extensive erosion and sediment problems in some parts of the area.

Elevation and topography: Elevation is about 200 m. Long, rolling ridges in the central and southern parts have broad, gently sloping crests. The land is more sloping in the north, and some hills rise above

300 m. Gently sloping or nearly level river terraces and flood plains are along waterways.

Climate: *Average annual precipitation*—925 to 1,025 mm. Precipitation is fairly evenly distributed throughout the year. Snowfall is heavy in winter. *Average annual temperature*—3 to 6°C. *Average freeze-free period*—100 to 120 days.

Water: Precipitation and the many perennial streams provide an abundance of water. Ground water is plentiful in the outwash and alluvium in the valleys but is scarce in the till and bedrock on the uplands.

Soils: Most of the soils are Orthods and Ochrepts. They are medium textured to coarse textured and have a frigid temperature regime, an udic moisture regime, and mixed mineralogy. Deep, well drained, Fragiorthods (Plaisted series), Fragiocrepts (Perham series), and deep, moderately well drained to somewhat poorly drained Fragiorthods (Howland series) are on glacial till ridges. All these soils are gently sloping to sloping. Shallow, somewhat excessively drained, gently sloping to moderately steep Haplorthods (Thorndike series) are on glacial till ridges. Excessively drained to well drained Haplorthods (Colton, Stetson, and Allagash series) are on glacial outwash deposits, mostly in the valleys. Deep, well drained, gently sloping to sloping Dystrochrepts (Caribou series) are on glacial till ridges. Deep, poorly drained, nearly level to gently sloping Fragiocrepts (Monarda series) are on glacial till ridges. Udifluvents on flood plains are important to agriculture, but their extent is small.

Potential natural vegetation: This area supports northern hardwood forest vegetation. Sugar maple, yellow birch, beech, and hemlock are on the better drained soils of the hills and ridges. Spruce species and balsam fir are on the wetter, long, gentle slopes and in depressions.

S—NORTHERN ATLANTIC SLOPE DIVERSIFIED FARMING REGION

105,780 km² (40,840 mi²)

This temperate, humid region consists of coastal lowlands, coastal plains, the piedmont, and ridges and valleys. The average annual precipitation is 900 to 1,275 mm in most of the region but is only 825 to 925 mm in the ridges and valleys in western Maryland and in West Virginia. Precipitation is slightly higher during spring and summer than during the remainder of the year. The average annual temperature is 8 to 14°C. In most of the region the freeze-free period ranges from 180 to 200 days, but it ranges from 120 days in the mountains to 220 days along the Atlantic Ocean and the Chesapeake Bay.

Udalfs, Udults, and Ochrepts are the dominant soils. These soils commonly have a fragipan. Aquults and Aquepts occupy lowlands and depressions, particularly on the coastal plains. Soils on the flood plains, mainly Ochrepts and Fluvents, are of minor extent. Hydraquents, Sulfaquents, and Sulfighemists are in tidal marshes along the Chesapeake Bay and the Atlantic Ocean. Psamments are of major extent on the Long Island-Cape Cod coastal lowland and of minor extent on the coastal plains.

Farming is highly diversified. Truck crops, fruits, and poultry are important sources of income, particularly on the coastal plains. Forage crops, soybeans, and grain for dairy and beef cattle are also important. Many large-scale corporate farms on the coastal plains are associated with the canning and frozen food industries. Many farms are operated part time by people who earn most of their living in the cities. Rural residences occupy many sites that are less favorable for farming. Throughout the region, urban areas are encroaching on farmland. Steep slopes are largely in forests used for timber production and for recreation.

147—Northern Appalachian Ridges and Valleys

Maryland, Pennsylvania, Virginia, and West Virginia
48,210 km² (18,610 mi²)

Land use: Most of this area is in farms. About 12 percent is used for urban development or consists of land altered by urbanization or other activities. Approximately 30 percent is cropland. A wide variety of crops are grown, mainly corn, small grains, and forage for dairy and beef cattle. Other important crops include potatoes, soybeans, apples, peaches, and some tobacco and vegetables. Dairy, beef and poultry farms are major enterprises. About 5 percent of the area is permanent pasture. Less than 60 percent is in hardwood forests that are mainly in small to medium-size holdings and some larger tracts of state forests, game lands, and parks. Much of the prime farmland in the valleys is urbanized.

Elevation and topography: Elevation ranges from 100 to 300 m in the valleys and from 400 to 800 m on ridges and mountains, but on some mountain crests it is 900 m. Parallel sandstone and shale ridges are separated by narrow to moderately broad limestone and shale valleys. Ridges have hilly to steep slopes and narrow rolling crests; valleys are mainly undulating to rolling but are hilly locally. Local relief in the valleys is about 5 to 50 m; ridges rise about 100 m above adjoining valleys.

Climate: *Average annual precipitation*—900 to 1,275 mm. Maximum precipitation is in spring and in summer, and the minimum is in fall. About 525 to 650 mm falls during the growing season. The average annual snowfall is 60 to more than 130 cm. *Average*

annual temperature—8 to 13°C. *Average freeze-free period*—120 to 170 days; the shorter growing seasons are at the higher elevations and in the north.

Water: Water is plentiful in this area. Springs, wells, farm ponds, reservoirs, and streams are the principal sources of water. The major streams are the Susquehanna and Potomac Rivers. Raystown Lake on the Raystown Branch of the Juniata River is one of the largest reservoirs in the area. Ground water is plentiful; the better producing wells are in the limestone valleys. Mineralized water and pollution of ground water are common land use problems.

Soils: Most of the soils are Udalfs, Udults, and Ochrepts. They have a mesic temperature regime, udic and aquic moisture regimes, and mixed mineralogy. Nearly level to sloping, deep, well drained, medium textured to fine textured Hapludalfs (Hagerstown, Duffield, Edom, and Washington series) are in the limestone valleys. Gently sloping to sloping, deep, well drained or moderately well drained, medium textured to fine textured Hapludults (Allenwood, Bedington, Frankstown, Mertz, and Murrill series), Fragiudults (Buchanan and Laidig series), and Paleudults (Frederick series) are on the lower foot slopes of the ridges and in the valleys. Most of these soils formed in residuum, colluvium, or glacial till derived from limestone, cherty limestone, sandstone, and shale. Sloping to steep, well drained, shallow to deep, medium textured Dystrochrepts (Berks, Calvin, Dekalb, Hazleton, and Weikert series) are on ridges and on the more sloping sites in the valleys.

Potential natural vegetation: This area supports hardwood forest vegetation. White oak, red oak,

black oak, hickories, and associated upland hardwoods are the major species. Scarlet oak, chestnut oak, hickories, and scattered Virginia pine, shortleaf pine, and white pine are common on dry ridges and shallower soils. Yellow-poplar, red oak, red maple, and other species that require more moisture grow in sheltered coves, on foot slopes, and on north-facing sites.

148—Northern Piedmont

Delaware, Maryland, New Jersey,
Pennsylvania, and Virginia
29,870 km² (11,530 mi²)

Land use: Approximately 65 percent of this area is in farms, and 35 percent is either used for urban development or is urbanizing rapidly. Farms are intensively cropped in Maryland, in Pennsylvania, and in most of New Jersey. They are mostly in pasture or woodland in the northern parts of New Jersey and in Virginia. Forage crops, soybeans, and grain for dairy cattle occupy the largest acreage of cropland. Wooded areas, consisting mostly of farm woodlots, are extensive on the steepest parts of the area. Large centers of population and industry stimulate urbanization throughout the area.

Elevation and topography: Elevation ranges from 25 to 300 m but dominantly is 100 to 300 m. On some ridges and isolated peaks, however, elevation is as much as 500 m or more. The dissected part of the Piedmont Plateau is underlain mainly by granite, gneiss, and schist. Basins are underlain by Triassic traprock, sandstone, shale, and conglomerate. The sedimentary rocks contain numerous dikes and sills of diabase and basalt. Other local areas are underlain by limestone. Topography is mostly gently sloping or sloping. Steeper slopes are mostly on the ridges at higher elevations or on side slopes adjacent to drainageways.

Climate: *Average annual precipitation*—900 to 1,150 mm. Maximum precipitation is in spring and early in summer. Droughts of 10 to 14 days are common in summer. *Average annual temperature*—10 to 14°C. *Average freeze-free period*—160 to 200 days.

Water: Precipitation and perennial streams are the important sources of water. Springs are common in rural areas and provide water for many farmsteads. Water for irrigation comes from streams, ponds, and wells. Shallow wells are important in rural areas, but most of the wells supply a limited quantity of water. Water for urban areas is supplied largely by municipal reservoirs.

Soils: The dominant soils are Udults, Udalfs, and Ochrepts. They have a mesic temperature regime, an udic moisture regime, and mostly mixed mineralogy. They are dominantly well drained, moderately deep or deep soils. Hapludults (Chester, Edneyville, Elioak, Eubanks, and Glenelg series) are dominant on the

uplands. Hapludalfs (Duffield, Hagerstown, Montalto, Neshaminy, and Washington series) are less extensive on the uplands. Shaly Hapludalfs (Penn series) and Dystrochrepts (Klinesville series) are common in the Triassic basins on the uplands. Dystrochrepts (Cardiff, Manor, and Mt. Airy series) are common on the steeper slopes. Associated with the dominant soils on the uplands are Hapludalfs (Lehigh, Mount Lucas, and Reaville series) and Fragiudalfs (Lawrence and Readington series). Soils on the flood plains are mainly Dystrochrepts (Bermudian, Codorus, Comus, and Rowland series) and Fluvaquents (Bowmansville and Hatboro series).

Potential natural vegetation: This area supports deciduous hardwood forest vegetation. Chestnut oak, white oak, red oak, hickories, ash, American elm, and yellow-poplar are major species. Yellow-poplar is abundant on the northeast slopes. Tree growth and wood production is considerably less in the Triassic basins than elsewhere in the area. Black walnut and black cherry grow on the well drained sites on flood plains. Eastern redcedar is common on many abandoned cropland areas.

149A—Northern Coastal Plain

Delaware, Maryland, and New Jersey
20,870 km² (8,060 mi²)

Land use: About 60 percent of this area is woodland, 20 percent cropland, less than 5 percent pasture, and 15 percent urban. About 50 percent is in farms. Major crops are vegetables, corn, soybeans, small grains, and fruits. Tobacco is a special crop in Maryland. Special crops in New Jersey are highbush blueberries and cranberries. Forage crops and grains for dairy cattle are important locally. Poultry, nursery stock, and sod farms also are important enterprises locally. Most woodland is in farm woodlots, but some is in large holdings. Pine pulpwood and hardwood lumber are the principal forest products. State forests and parks are extensive in places. A narrow band along the coast is intensively developed for resorts and for recreation. The urban developments are expanding rapidly. Improved drainage is needed on almost 25 percent of the farmland.

Elevation and topography: Elevation ranges from sea level to 100 m, but it is less than 50 m in most of the area. This nearly level to rolling dissected coastal plain is underlain by unconsolidated sand, silt, and clay. Local relief is mostly 2 to 10 m, but it is 30 m or more in a few places.

Climate: *Average annual precipitation*—900 to 1,275 mm. Most of the precipitation falls near the coast in midsummer. Snow ranges from little or none in the south to 75 cm in the north. *Average annual temperature*—10 to 13°C, decreasing from south to north and from the coast inland. *Average freeze-free*

period—170 to 210 days, decreasing from south to north and from the coast inland.

Water: Precipitation, perennial streams, and ground water provide an abundance of water. Domestic supplies are obtained mainly from shallow wells, but large supplies must be obtained from deep wells. In most years moisture is deficient in the coarse textured, well drained soils, and supplemental irrigation water from streams, ponds, and wells is used for high-value crops.

Soils: Most of the soils are Udults and Aquults. They are deep and medium textured to fine textured. These soils have a mesic temperature regime, an udic or aquic moisture regime, and mixed or siliceous mineralogy. Well drained Hapludults (Sassafras, Downer, Matapeake, Aura, Chillum, Sunnyside, Kempsville, Freehold and Collington series) and Paleudults (Caroline series) are mostly in high positions. Moderately well drained and somewhat poorly drained Hapludults (Hammonton, Woodstown, Mattapex, Keyport, Holmdel, and Adelphia series) are in intermediate positions on the landscape. Ochraqults (Fallsington, Elkton, Othello, and Shrewsbury series) are in associated low positions. There are also extensive areas of sandy soils, including Quartzipsamments (Lakewood, Lakehurst, Evesboro, and Klej series), Hapludults (Galestown series), and Dystrochrepts (Riverhead series). Sandy Haplaquods (Atison and Berryland series) are in associated low positions. Sulfaquents, Sulfhemists, and Hydraquents are in mineral and organic tidal marshes.

Potential natural vegetation: This area supports pine and hardwood forest vegetation. Loblolly pine, Virginia pine, shortleaf pine, southern red oak, black oak, scarlet oak, pin oak, willow oak, northern red oak, black walnut, yellow-poplar, sweetgum, and red maple are dominant species.

149B—Long Island-Cape Cod Coastal Lowland

Massachusetts and New York
6,830 km² (2,640 mi²)

Land use: About one-half of this area is used for urban development, and urban expansion is continuing. Recreation uses are extensive along shorelines. Cropland accounts for less than 10 percent of the area. Cash crops and vegetables such as potatoes, cauliflower, and cabbage are particularly important. In a few places duck and poultry farms are important enterprises. About 25 percent of the land is forested.

Elevation and topography: Elevation ranges from sea level to 25 m, but a few places rise as much as 100

m. Nearly level to rolling plains of deep unconsolidated outwash deposits of sand and gravel are dominant. Steeper morainic hills and ridges border the lower plains. Local relief is mainly 1 to 10 m but is as much as 20 m in the more hilly areas.

Climate: *Average annual precipitation*—1,025 to 1,150 mm. Precipitation is fairly evenly distributed throughout the year. Snowfall is moderate to low in winter. Extended periods of no snow cover can be expected in winter because of the relatively moderate temperatures. *Average annual temperature*—10 to 13°C. *Average freeze-free period*—180 to 220 days, but in most places it is 200 to 210 days.

Water: In most years precipitation is adequate for crops. High-value vegetable crops grown on the drier sandy soils usually require irrigation for optimum yields. The deep sand and gravel deposits underlying most of the area are excellent aquifers and are good sources of irrigation water. Encroachment of saltwater from the surrounding ocean is a continuing hazard to these freshwater aquifers. There are only a few perennial streams, rivers, and lakes. Coastal inlets and bays provide many recreation and transportation opportunities.

Soils: Most of the soils are Ochrepts or Psamments. They are deep, moderately coarse textured and coarse textured. These soils have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Nearly level to sloping, well drained Dystrochrepts (Riverhead and Haven series) are on outwash plains, terraces, and remnant beach ridges underlain by sand and gravel deposits. Excessively drained Udipsamments (Carver and Plymouth series) are also extensive on sandy outwash plains and in steeper hilly areas. Well drained to moderately well drained Fragiochrepts (Montauk series) are in some morainic areas dominated by glacial till. Somewhat poorly drained and poorly drained Psammaquents (Wareham series) and Haplaquepts (Walpole and Raynham series) in low areas and in drainageways are of small extent but are important locally. Sand dunes and tidal marsh are extensive along the coastline.

Potential natural vegetation: This area supports forest vegetation of hardwoods and softwoods. Extensive areas of the oak-pitch pine forest grow on the droughty, sandy soils. Oak and beech-birch-sugar maple are other potential forest types. White and red pine can be expected in many areas. Barberry and lowbush blueberry are common early succession types in burned-over areas. Sand dunes have potential for American beachgrass on foredunes and a mixture of bayberry, sassafras, and American holly on the more protected dunes.

T—ATLANTIC AND GULF COAST LOWLAND FOREST AND CROP REGION

247,140 km² (95,420 mi²)

This region consists of the nearly level low parts of the Atlantic and Gulf Coastal Plains. Elevation ranges from sea level to about 100 m. The average annual precipitation is 1,025 to 1,525 mm in most of the region but decreases sharply to about 625 mm in the extreme western part. The Mississippi River Delta, however, receives as much as 1,650 mm. The average annual temperature is 18 to 21°C in much of the region but decreases to 13°C in the north. The freeze-free period ranges from 200 days in the north to 350 days in the south.

Aquults, Aqualfs, Udults, and Aquepts are the dominant soils in the eastern part of the region. Aquents, Psamments, Aquods, and Histosols are important locally. Uderts, Aqualfs, Aquolls, Aquepts, and a few Histosols (locally) are dominant in the west. Most soils require drainage if they are used for crops.

Most of the land in the east is forested. Forest, pasture, recreation, and range are important land uses in the west. Rice is an important crop in the west. Other important crops are soybeans and corn. Grain sorghum, vegetables, tobacco, and peanuts are important crops locally.

150A—Gulf Coast Prairies

Louisiana and Texas

41,710 km² (16,100 mi²)

Land use: Most of this area is in farms, and nearly 40 percent is used for crops or hay. Rice, soybeans, grain sorghum, cotton, corn, and hay are the chief crops. About one-third of the area is range or pasture. About one-sixth is in forests, chiefly hardwood, bordering the rivers and streams that cross the area. In some places, urban development is rapidly expanding onto cropland and agricultural land.

Elevation and topography: Elevation ranges from sea level to about 50 m along the interior margin. The Gulf Coast Prairie is a nearly level area with low local relief.

Climate: *Average annual precipitation*—625 to 1,400 mm, increasing from west to east. Precipitation is fairly evenly distributed, but it is slightly higher in midsummer and late in summer in the west and slightly higher in winter in the east. *Average annual temperature*—20 to 21°C. *Average freeze-free period*—280 to 320 days.

Water: Rainfall and perennial streams provide abundant water. Water for irrigating rice is obtained from streams and in some places from wells. Ground water is abundant. Most of the soils must be drained for optimum growth of general farm crops.

Soils: Uderts are dominant in the western and central parts. They are deep, clayey soils that have a very slowly permeable subsoil and montmorillonitic mineralogy. Aqualfs are dominant in the eastern part. They are deep and loamy and have a clayey, very slowly permeable subsoil, an aquic moisture regime, and montmorillonitic mineralogy. Most of the soils have a thermic temperature regime, but those south and west of Lavaca Bay have a hyperthermic temperature regime. Poorly drained and somewhat poorly drained, nearly level Pelluderts (Beaumont and Lake Charles series) and Pellusterts (Victoria series) are on lowlands. Poorly drained and somewhat poorly

drained Albaqualfs (Crowley and Edna series), Ochraqualfs (Midland and Orelia series), and Glossaqualfs (Mowata series) are on slightly concave lowlands. Argiaquolls (Bernard and Morey series) and Haplaquolls (Kaman series), Fluvaquents (Mantachie series), and Haplaquepts (Urbo series) are on the flood plains of the Brazos and Trinity Rivers. The entire area is underlain by unconsolidated sediments.

Potential natural vegetation: This area supports a true prairie plant community. Little bluestem, indiangrass, switchgrass, and big bluestem are the dominant species. A few groves of live oak dot the landscape.

150B—Gulf Coast Saline Prairies

Texas

13,100 km² (5,060 mi²)

Land use: Most of this area is in ranches or is used for recreation. More than 75 percent is in native range consisting mainly of salt-tolerant plant species. A small acreage is used for bermudagrass pasture for beef cattle, rice, and grain sorghum. The remainder is mostly used for wildlife and for recreation. Deer, ducks, geese, and wild hogs are common in much of the area. Urban and recreation developments are expanding, especially along the barrier islands in the central and southern parts of the area.

Elevation and topography: Elevation ranges from sea level to about 3 m, but it is as much as 8 m on some of the dunes. The area is mostly nearly level to gently sloping coastal lowlands and island flats along the Gulf of Mexico. Parts of the area have been worked by wind, and the sandy parts have a gently undulating to irregular topography because of low mounds or dunes. Relief is mainly less than 1 m. Streams flowing into the bays have broad shallow flood plains.

Climate: *Average annual precipitation*—750 to about 1,400 mm. In the southwest precipitation is abundant in spring and in fall. In the northeast precipitation is

evenly distributed throughout the year. *Average annual temperature*—21 to 23°C. *Average freeze-free period*—250 to 330 days.

Water: The lowest parts of the area are covered by high tides, and the remainder is periodically covered by storm tides. Rainfall is the source of water for pasture and range. A few freshwater streams and rivers flow into the area from the north, and there are many bays and small entrapments of salty waters throughout the area. There is little underground freshwater. Livestock water comes mainly from dug-out ponds or shallow wells that tap thin shallow strata of freshwater. Freshwater for urban uses is piped in from outside the area.

Soils: The dominant soils are Aquents, Aqualfs, Aquolls, and Aquepts. They are mostly saline, somewhat poorly drained to poorly drained, deep, and fine textured to coarse textured. These soils have a hyperthermic and thermic temperature regime, an aquic moisture regime, and montmorillonitic, mixed, or siliceous mineralogy. Psammaquents (Mustang, Tatton, and Dianola series), Udipsamments (Galveston series), Fluvaquents (Bayucos series), and Salorthids (Segita series) are on offshore barrier islands and near shore along the bays. Nearly level to very gently sloping Haplaquolls (Harris series), Natraqualfs (Livia, Narta, and Matagorda series), Pelluderts (Francitas series), and Pellusterts (Lomalta series) are on low coastal terraces. Undulating sandy Ochraqualfs (Roemer series), Albaqualfs (Rahal series), and Paleudalfs (Portalto series) are on wind-worked plains. Haplaquolls (Aransas series), Haplaquents (Austwell series), and Fluvaquents (Placedo and Veston series) are on coastal flats and flood plains of major streams in the area.

Potential natural vegetation: This area supports grassland vegetation. The more saline soils support a plant community dominantly of gulf cordgrass and smaller amounts of little bluestem, switchgrass, sea-shore saltgrass, inland saltgrass, bushy sea-oxeye, marshhay cordgrass, rushes, sedges, and pickleweed. The less saline sandy soils support a plant community dominantly of little bluestem and lesser amounts of switchgrass, gulfdune paspalum, and marshhay cordgrass.

151—Gulf Coast Marsh

Louisiana

21,030 km² (8,120 mi²)

Land use: Most of this area is in marsh vegetation and is used mainly for wildlife habitat. The area is almost treeless and uninhabited. It is part of the fertile and productive estuarine complex that supports marine life of the Gulf of Mexico. The area provides wintering ground for millions of ducks and geese and habitat for many fur-bearing animals and alligators. A signifi-

cant acreage west of Vermillion Bay is firm enough to support livestock and is used for winter grazing of cattle. A small acreage of freshwater marsh is drained by pumping systems and is used for pasture and for the production of rice.

Elevation and topography: Elevation ranges from sea level to about 2 m. On beach ridges, canal spoil banks, and natural levees, elevation is as much as 3 m, and on the salt dome islands, it is as much as 50 m. The land east of Vermillion Bay, part of the Mississippi River deltaic plain, has a ragged shoreline and is made up of recent alluvial and marine sediments. The land west of Vermillion Bay is made up of older alluvial and marine sediments and has a smoother shoreline. Low, narrow, elongated sandy ridges characterize much of the area. There are many rivers, lakes, bayous, tidal channels, and manmade canals.

Climate: *Average annual precipitation*—1,225 to 1,650 mm, increasing from west to east. During the growing season, precipitation ranges from 900 to 1,150 mm. *Average annual temperature*—About 21°C. *Average freeze-free period*—280 to 350 days, increasing from north to south.

Water: This area contains many rivers, lakes, bayous, tidal channels, and manmade canals. About one-half of the marsh is fresh, and one-half is salty. Tidal channels provide free movement of salty water from the Gulf of Mexico into parts of the Gulf Coast Marsh adjacent to the Gulf. Most of the area is susceptible to flooding either by freshwater drained from lands adjacent to the marsh or by saltwater from the Gulf of Mexico. Daily tides flood some parts. Tides resulting from hurricanes or tropical storms are as much as 3 m above sea level and flood most of the area. Notable ground water is scarce east of Vermillion Bay. Hard ground water is available in moderate to large quantities west of Vermillion Bay.

Soils: The dominant soils are Aquolls, Sapristis, Aquents, and Hemists. They have a thermic temperature regime and an aquic moisture regime. Most of the soils of the Gulf Coast Marsh are very poorly drained, and their water table is at or above the surface most of the time. These soils are susceptible to frequent flooding. They formed in alluvial and marine sediments and organic accumulations. The Aquolls are firm, but the other soils are soft and can sustain little weight. West of Vermillion Bay, Haplaquolls (Harris series) are dominant. Soils with a thin surface layer of peat or muck and Medisapristis (Kenner, Lafitte, and Allemands series), Hydraquents (Gentilly and Scatlake series), and floating Medihemists (Carlin series) are dominant.

Potential natural vegetation: This area supports freshwater and saltwater marsh vegetation of grasses, sedges, rushes, and other plants. Alligatorweed, spikerush, maidencane, cutgrass, and bulltongue char-

acterize the freshwater vegetation. Roseau, common reed, bulltongue, and marshhay cordgrass characterize the intermediate water vegetation. Marshhay cordgrass, saltgrass, and Olney bulrush are typical of the brackish water vegetation. Saltgrass, marshhay cordgrass, smooth cordgrass, and black needlerush are included in the saline water vegetation.

152A—Eastern Gulf Coast Flatwoods

Alabama, Florida, and Mississippi

34,120 km² (13,170 mi²)

Land use: Very little of this area is in farms. Much of it is in large holdings owned by pulp and paper companies. Part of it is in state and national forests or is used as game refuges and for military training areas. Nearly nine-tenths of the area is forested; pulpwood and lumber are the principal forest products. Some of the woodland is grazed. Only about 4 percent is cropped and a like amount is in pasture. Corn, peanuts, tobacco, and soybeans are the major crops. Some fruits and vegetables are produced, mainly for home consumption.

Elevation and topography: Elevation ranges from sea level to 25 m. This nearly level low coastal plain is crossed by many large streams. The areas in Florida have many lakes and ponds. Local relief is a few meters.

Climate: *Average annual precipitation*—1,325 to 1,625 mm. Minimum precipitation is early in autumn and in midautumn, increasing moderately in winter and early in spring, with lesser amounts in May. Maximum precipitation is in summer. *Average annual temperature*—19 to 21°C. *Average freeze-free period*—270 to 290 days.

Water: The abundant rainfall and the many perennial streams are important sources of water. Ground water is plentiful but is affected by salt in many places near the coast.

Soils: The dominant soils are Aquults, Aquepts, and Aquods. They have a thermic temperature regime and an aquic moisture regime. They are sandy and poorly drained or very poorly drained. Paleaquults (Plummer and Pelham series) have a loamy subsoil. Humaquepts have a dark surface layer. Haplaquods (Leon and Mascotte series) have a weakly cemented layer at a depth of about 2 ft. Other important soils are sandy, moderately well drained and excessively drained Quartzipsamments (Chipleys, Kurebs, and Lakeland series), very poorly drained Sulfaquents, Sulfighemists, and possibly Hydraquents near the coast.

Potential natural vegetation: This area supports pine forest vegetation. Chalky bluestem, indiangrass, and several panicum species make up the understory. Palmetto, gallberry, and waxmyrtle are the dominant woody shrubs. Longleaf and slash pine are the major trees.

152B—Western Gulf Coast Flatwoods

Louisiana and Texas

16,890 km² (6,520 mi²)

Land use: Most of this area is in farms, and about three-fourths is forest, principally pine and pine-hardwood. Much of the forest acreage is owned by large corporations, and lumber and pulpwood are the chief products. Cleared areas are used mostly for pasture, but some are used for crops. Rice, grain sorghum, corn, and soybeans are commonly grown. Many small subdivisions are being developed throughout the area.

Elevation and topography: Elevation ranges from 25 to 100 m. This area is nearly level to gently sloping and has a low local relief.

Climate: *Average annual precipitation*—1,175 to 1,400 mm, increasing from west to east. Precipitation is evenly distributed throughout the year but is slightly greater in the east during winter. *Average annual temperature*—19 to 21°C. *Average freeze-free period*—260 to 280 days.

Water: Rainfall, perennial streams, and ground water provide an abundance of water. Most of the soils must be drained for optimum growth of general farm crops.

Soils: Most of the soils have a water table near the surface during at least part of the year. The dominant soils are Udalfs. They are deep and medium textured or moderately coarse textured. These soils have a thermic temperature regime, an udic moisture regime, siliceous mineralogy, and a weak fragipan or plinthite. Somewhat poorly drained Fragiudalfs (Splendora series), moderately well drained Paleudalfs (Segno and Hockley series), and poorly drained Ochraqualfs (Sorter and Acadia series) are dominant in Texas. Poorly drained Glossaqualfs (Caddo series) and Paleudults (Beauregard series) are dominant in Louisiana. Poorly drained Glossaqualfs (Waller, Wrightsville, Guyton, Aldine, and Ozan series) are in depressions. Moderately well drained Paleudults (Malbis series) and well drained Paleudults (Ruston series) are on some of the higher ridges. Fluvaquents (Mantachie series), Eutrochrepts (Marietta series), Haplaquepts (Urbo series), and Glossaqualfs (Guyton series) are on the bottom land of the streams. The entire area is underlain by unconsolidated sediments.

Potential natural vegetation: This area supports pine-hardwood forest vegetation characterized by longleaf pine. Sweetgum, blackgum, post oak, black-jack oak, and southern red oak are the principal hardwood species. Hawthorns, myrtle, and shining sumac make up the woody understory. Mid and tall grasses are dominant in open areas. Little bluestem, pinhole bluestem, big bluestem, switchgrass, and indiangrass are the principal grasses. Longleaf uniola, Virginia wildrye, Florida paspalum, beaked panicum,

and several low-growing panicums and paspalums are the principal grasses in shady areas. Lespedezas, tickclovers, wildbeans, and several composites constitute the principal forbs of the area.

153A—Atlantic Coast Flatwoods

Florida, Georgia, North Carolina, South Carolina, and Virginia
73,760 km² (28,480 mi²)

Land use: Most of this area is in farms, but some is in national forests or is used as game refuges and for related purposes. About 70 percent is in forests. Some are farm woodlots, but most are large holdings. Pulpwood is the main wood product; lumber and naval stores are other sources of income from forests. About 20 percent of the area is cropland, and about 1 to 4 percent is pasture. The proportion of cropland is somewhat higher in the north and is considerably lower in Florida. Vegetable crops, fruits, melons, sweetpotatoes, and Irish potatoes are important crops. There are large acreages of corn, soybeans, wheat, and tobacco. Some peanuts are grown on the sandy soils in Virginia and in Georgia. Poultry farming is an important enterprise in the north and in some parts of Florida.

Elevation and topography: Elevation ranges from 25 to 50 m. Some short steep slopes border the stream valleys. The area is crossed by many broad shallow valleys that have widely meandering stream channels. Local relief is mainly less than 10 m.

Climate: *Average annual precipitation*—1,025 to 1,400 mm. Maximum precipitation is in summer. *Average annual temperature*—13 to 21°C. *Average freeze-free period*—200 to 280 days.

Water: Rainfall, perennial streams, and ground water provide an abundance of water. Water for domestic, municipal, and industrial uses is obtained mainly from wells. Many of the soils require artificial drainage before they can be used for crops, and some of the sandy soils need irrigation during droughts.

Soils: Soils having restricted drainage are dominant throughout the area. Most extensive are Aquults. They have a thermic temperature regime and an aquic moisture regime. They are deep and medium textured to fine textured. Paleaquults (Rains, Coxville, and Lynchburg series) and Ochraqults (Rembert series) are most common. The Paleaquults (Byars, Bayboro, and Pantego series) and Umbraqults (Paxville series) are on associated wetter sites. Hapludults and Paleudults (Goldsboro, Persanti, Bertie, Johns, Kempsville, Suffolk, and Foreston series) are on higher sites where drainage is somewhat better. Other locally important soils are Haplaquods (Leon, Mascotte, and Lynn Haven series), Quartzipsamments (Lakeland series), and Paleudults (Blanton and Troup series). Histosols occupy fairly large areas, especially in the Okefenokee Swamp of Georgia and Florida.

Potential natural vegetation: This area supports

pine-oak forest vegetation. Loblolly pine and upland oaks are dominant on the uplands, and water tupelo, swamp blackgum, sweetgum, and oaks are dominant on the bottom lands. Longleaf uniola, cutover muhly, toothachegrass, panicums, little bluestem, and associated grasses and forbs characterize the understory vegetation.

153B—Tidewater Area

Maryland, North Carolina, and Virginia
31,020 km² (11,980 mi²)

Land use: Most of this area is in farms, but some is in national forests or is used as game refuges, for urban developments, and for related purposes. About 70 percent of the area is in forests. Some are farm woodlots, but most are in large holdings. Pulpwood is the main wood product; lumber and naval products are other sources of income from forests. About 15 percent is cropland, and a very small acreage is pasture. There are large acreages of corn, soybeans, tobacco, and vegetables. Recreation enterprises are important, and coastal marshes make up 5 to 10 percent of the area.

Elevation and topography: Elevation ranges from sea level to less than 25 m. The Suffolk Scarp is the upper limit of this area. The nearly level coastal plain is crossed by many broad shallow valleys that have meandering stream channels. Most of these valleys terminate in estuaries along the coast. Local relief is mainly about 1 m or less.

Climate: *Average annual precipitation*—1,150 to 1,275 mm. Maximum precipitation is in summer, and the minimum is in autumn. *Average annual temperature*—13 to 24°C. *Average freeze-free period*—200 to 300 days.

Water: Rainfall, perennial streams, and ground water provide an abundance of water. Water for domestic, municipal, and industrial uses is obtained mainly from wells. Many soils require artificial drainage before they can be used for crops, but during droughts irrigation is needed on some of the sandy soils.

Soils: The dominant soils are Aquults and Aqualfs. They have restricted drainage, a thermic temperature regime, an aquic moisture regime, and dominantly mixed mineralogy. Deep, medium textured to fine textured Ochraqults (Tomotley, Yemassee, and Wahee series), Umbraqults (Cape Fear and Portsmouth series), Ochraqualfs (Argent and Yonges series), and Albaqualfs (Meggett series) are extensive. Hapludults (Bertie and Tetotum series) are on higher sites where drainage is better but somewhat restricted. Other important soils are Haplaquods (Baratari and Rosedhu series) and Udipsamments (Wando, Newhan, Corolla, and Fripp series). Histosols occupy large areas in North Carolina and in the Dismal Swamp of Virginia.

Potential natural vegetation: Loblolly pine and some oaks are dominant on the uplands, and blackgum,

sweetgum, oaks, water tupelo, and baldcypress are dominant on the bottom lands. Longleaf uniola, switchcane, panicums, little bluestem, inkberry, large gallberry, greenbrier, waxmyrtle, cabbage palm, and associated grasses and forbs characterize the understory vegetation.

153C—Mid-Atlantic Coastal Plain

Delaware, Maryland, and Virginia
15,510 km² (5,990 mi²)

Land use: About 65 percent of this area is in farms.

The area is about 45 percent woodland, 45 percent cropland, less than 5 percent pasture, and less than 5 percent urban. Corn, soybeans, small grains, vegetables, and fruit are major crops. Farming is highly diversified; poultry, truck crops, or fruit crops exceed general farming in importance in some counties. Many large-scale corporate farms produce these specialized crops. Sod farms are important locally. Many large tracts of loblolly pine on wet soils are managed for timber production. State forests and parks are extensive in places. A narrow bank along the Atlantic coast is intensively developed for resorts and recreation. The seafood industry is significant to the economy of counties bordering the Chesapeake Bay.

Elevation and topography: Elevation ranges from sea level to about 25 m. This nearly level to gently sloping coastal plain is underlain by unconsolidated sand, silt, and clay. Local relief is only a few meters, even where flood plains or coves from the bay are incised.

Climate: *Average annual precipitation*—1,175 mm; *snowfall* is about 37 cm. *Average annual temperature*—13 to 14°C. *Average freeze-free period*—

185 days inland to 220 days along the Atlantic Ocean and the Chesapeake Bay.

Water: Rainfall, perennial streams, and ground water provide an abundance of water. Water for domestic, municipal, and industrial uses is obtained mainly from wells. Many of the soils require artificial drainage before they can be used for crops, but during droughts irrigation is needed on some of the sandy soils.

Soils: The dominant soils are Udults. They have a mesic temperature regime, an udic moisture regime, and mixed or siliceous mineralogy. These soils are mostly deep and well drained and moderately well drained. In the north, Hapludults (Matapeake and Mattapex series) formed in 1 to 3 ft of loess over sandy and clayey stratified coastal plain deposits. In the south, Hapludults (Sassafras and Woodstown series) formed in coastal plain materials lacking the silty loess mantle. Interspersed are Ochraquults (Fallsington, Elkton, and Othello series), which are dominant in the extreme south. Quartzipsammments (Evesboro series) occupy high ridges in the south. Extensive areas of tidal marsh are along the Chesapeake Bay and the Atlantic Ocean consisting of both Histosols and Hydraquents. Along the Atlantic Ocean there is a strip of coastal beach dune sand.

Potential natural vegetation: This area supports oak-pine forest vegetation. Shortleaf pine, baldcypress, and Virginia pine are major softwood species. Hardwoods make up most of the commercial timber volume in the area. Oaks, mainly southern red, northern red, scarlet, willow, black, and white oak, are dominant. Other trees are yellow-poplar, blackgum, sweetgum, red maple, and hickories.

U—FLORIDA SUBTROPICAL FRUIT, TRUCK CROP, AND RANGE REGION

94,550 km² (36,510 mi²)

This region consists of the southern two-thirds of the Florida peninsula. The average annual precipitation is 1,275 to 1,625 mm. The average annual temperature is 21 to 25°C. The freeze-free period ranges from 290 days in the north to 365 days in the south. A large part of the region is south of the southern limit of annual frost.

Psammments and Udufts are the dominant soils at high elevations. Aquults, Aqualfs, Aquods, and Aquents are dominant at low elevations. Locally, Sapristis and Fibrists are dominant. Many of the low-lying soils require drainage if they are used for crops.

Citrus fruits, other subtropical fruits, and winter vegetables are the major crops throughout the region. The acreage in pasture and range, however, is somewhat greater than that in crops. More than two-thirds of the region is in forest or other native vegetation, much of which is grazed. Beef cattle are the principal livestock, and dairying is an important enterprise near the larger cities. In the south, sugarcane is a major crop locally.

154—South-Central Florida Ridge

Florida

24,290 km² (9,380 mi²)

Land use: About 40 percent of this area is in forest, including the Ocala National Forest. Pulpwood is the chief forest product, but some lumber is produced. Some of the forests are grazed. Although only about 5 percent of the area is in crops, this is the major citrus-producing area in Florida. Many kinds of winter vegetables also are grown. About 25 percent of the area is pasture, about one-half of which is improved and intensively managed. Beef cattle are the principal livestock, and dairying is an important enterprise near some of the large cities. Phosphate mines are a prominent feature in the central part of the area.

Elevation and topography: Elevation ranges from 25 to 50 m, but some hills are as much as 100 m, and a narrow strip along the western edge is at sea level. The nearly level to gently rolling coastal plain has a sandy mantle of varying thickness over limestone. The land surface is very irregular because of the many sinkholes that dot the area. Local relief is mainly a few meters, but in places it is 25 m or more.

Climate: *Average annual precipitation*—1,275 to 1,400 mm. Maximum precipitation is in summer, and the minimum is late in autumn and in winter. *Average annual temperature*—21 to 23°C. *Average freeze-free period*—290 to 350 days.

Water: Rainfall and ground water supply an abundance of water. Wells in the cavernous limestone underlying much of the area yield large quantities of water that is highly mineralized but otherwise of good quality. There are many lakes in the sinkholes throughout the area but few perennial streams.

Soils: The dominant soils are Psammments and Udufts. They have a hyperthermic temperature regime and an udic moisture regime. Excessively drained to moderately well drained Quartzipsammments (Astatula, Candler, Tavares, and Gainesville series) are sandy throughout. Well drained and somewhat poorly drained

Paleodults (Arrendondo, Apopka, Kendrick, Sparr, and Lochloosa series) have very thick and thick sandy layers over a loamy subsoil. Poorly drained, sandy Aquults and Aqualfs (Blichton, Boardman, Flemington, Fellowship, and Wacahoota series), which have a loamy and clayey subsoil, formed in sloping areas in phosphatic materials.

Potential natural vegetation: This area supports “sand hill” vegetation. Turkey oak, bluejack oak, and longleaf pine are major species. Running oak, gopher apple, and such grasses as bluestems and panicums characterize the understory.

155—Southern Florida Flatwoods

Florida

54,570 km² (21,070 mi²)

Land use: About 65 percent of this area is in forest, consisting mainly of spaced pine of low quality. The forests are grazed extensively. About 15 percent of the area is improved pasture, and the same proportion is native range grazed by cattle. Only about 3 percent is cropped, principally to many kinds of winter vegetables. Some citrus fruits are grown, and other subtropical fruits are grown in the south.

Elevation and topography: Elevation ranges from sea level to 25 m, increasing gradually from the coast inland. The nearly level coastal plain is mantled by sand of varying thickness over limestone. The many swamps, marshes, lakes, and streams are prominent landscape features. Most of the area is flat, but some hummocks rise a meter above the general level.

Climate: *Average annual precipitation*—1,300 to 1,525 mm. Maximum precipitation is in summer, and the minimum is late in autumn and in winter. *Average annual temperature*—21 to 23°C. *Average freeze-free period*—290 to 365 days.

Water: Rainfall, surface water, and ground water provide an abundance of water. On much of the cropland, ground-water levels are controlled by canals and ditches. Excess water is pumped out during the rainy season, and irrigation water is applied

during the growing season. Domestic and municipal water supplies are obtained mainly from wells in the underlying limestone. Water from this source is highly mineralized.

Soils: The dominant soils are Aquods, Aquepts, and Aquepts. They have a hyperthermic temperature regime and an aquic moisture regime. Poorly drained, sandy Haplaquods (Myakka and Immokalee, and Wabasso, Wauchula, Pomona, EauGallie, and Oldsmar series) have a weakly cemented layer at a depth of about 2 to 4 ft. Poorly drained Psammaquents (Basinger and Pompano series) and very poorly drained Humaquepts (Placid series) are sandy throughout. Locally, narrow to broad bands of Sulfaquents, Sulfihemists, and Hydraquents occur along and near the coast. Moderately well drained, sandy Haplohumods (Pomello series), which have weakly cemented layers, and excessively drained, sandy Quartzipsamments (St. Lucie and Paola series) are on low old beach ridges and dunes. They are of small extent but are important for urban expansion.

Potential natural vegetation: This area supports "flatwood" forest vegetation. Slash pine, longleaf pine, cabbage palm, and live oak are the principal species. Sawpalmetto and gallberry and such grasses as bluestems and wiregrasses characterize the understory.

156A—Florida Everglades and Associated Areas

Florida

11,210 km² (4,330 mi²)

Land use: About 50 percent of this area is used as Indian reservations, national parks, and game refuges and for other large holdings. About 35 percent is forested. Cypress forests are extensive, but mangrove forests are widespread along the eastern and southern coasts. A large part of the area is open marsh. Much of the area is used for hunting, fishing, and other recreation activities. About 13 percent is cropland. Winter vegetables are the main crop, but some citrus fruits, avocado, and papaya are grown on better drained sites. Sugarcane is an important crop on the organic soil south of Lake Okeechobee. The acreage of improved pasture, about 6 percent, is increasing. Beef cattle are the principal livestock, and dairying is an important enterprise locally. Urbanization is extensive along the eastern coast.

Elevation and topography: Elevation ranges from sea level to less than 25 m. The level, low coastal plain contains large areas of swamps and marshes. Poorly defined broad streams, canals, and ditches drain the area to the ocean. Most of the area is flat, but in the interior, hummocks rise a meter or two above the general level. Low beach ridges and dunes, mainly in the east, rise a few meters above the adjoining swamps and marshes.

Climate: *Average annual precipitation*—1,275 to 1,625 mm. Maximum precipitation is from late in spring through early autumn, and the minimum is during the remainder of autumn and in winter. *Average annual temperature*—22 to 25°C. *Average freeze-free period*—330 to 365 days.

Water: Rainfall, surface water, and ground water provide an abundance of water. Near the coast, some surface and ground water is salty. A large part of the area is flooded during the rainy season. Canals and ditches control the ground-water level for crops and pasture. Excess water is pumped out during the rainy season, and irrigation water is applied during the dry season. Domestic and municipal water supplies are obtained from wells in the underlying limestone. This water is highly mineralized.

Soils: The dominant soils are Saprists and Fibrists. They are very poorly drained, organic soils that have a hyperthermic temperature regime and an aquic moisture regime. Medisaprists (Terra Ceia, Pahokee, Lauderhill, and Dania series) are over limestone bedrock in the Everglades marsh. The more shallow soils are dominant in the southern part, and the deeper soils are dominant near Lake Okeechobee. Medifibrists (Montverde and Micco series) and Medisaprists (Tomoka series) are over mineral material in the St. Johns marsh. Also important are poorly drained, sandy Psammaquents (Hallandale and Margate series) and Ochraqualfs (Boca series) that are moderately deep to limestone. Especially important in Dade, Monroe, and Collier Counties are soils that are shallow and very shallow to limestone and marl. Sulfihemists and Sulfaquents are shallow to rock; they are along the coast.

Potential natural vegetation: This area supports freshwater marsh and swamp vegetation. Sawgrass, pickleweed, willow, buttonbush, and maidencane are the dominant marsh species. Baldcypress is the dominant swamp species. Mangroves grow in saltwater swamps along the eastern and southern coasts.

156B—Southern Florida Lowlands

Florida

4,480 km² (1,730 mi²)

Land use: Most of this area is in farms and ranches. About 20 percent is forest of mixed pine and cabbage palm or of cabbage palm and hardwoods. About an equal proportion of the remaining acreage is cropland, improved pasture, and rangeland. Citrus fruits, the chief crop grown, are planted in beds between shallow ditches that are part of the water-control system. Vegetation on the rangeland consists of native grasses, forbs, sedges, and a few scattered pines.

Elevation and topography: Elevation is about 25 m; the lower areas are near the St. Johns marsh and the Everglades. The very broad and nearly level low-

lands are mantled by sand over loamy materials and in a few places over limestone. Most of the area is almost flat, but some hummocks rise a meter or two above the general level.

Climate: *Average annual precipitation*—1,325 to 1,525 mm. Maximum precipitation is in summer, and the minimum is late in autumn and in winter. *Average annual temperature*—22 to 23°C. *Average freeze-free period*—330 to 360 days.

Water: Rainfall, surface water, and ground water provide an abundance of water. Unless practices are used to control the water level in naturally wet areas, shallow water covers the surface during much of the rainy season. Canals and ditches control the ground-water level for crops and pasture. Excess water is pumped out during the rainy season, and irrigation water is applied during the growing season. Domestic and irrigation water supplies are obtained mainly

from wells in the underlying limestone. Water from this source is highly mineralized.

Soils: The dominant soils are Aqualfs, Aquolls, and Aquods. They have a hyperthermic temperature regime and an aquic moisture regime. Poorly drained, sandy Glossaqualfs (Riviera, Winder, and Pineda series), poorly drained, sandy Ochraqualfs (Parkwood and Boca series) and very poorly drained Argiaquolls (Chobee, Floridana, and Manatee series) have a loamy subsoil. Poorly drained, sandy Haplaquods (Wabasso and Oldsmar series) have cemented layers at a depth of about 2 to 3½ feet underlain by loamy subsoil. Poorly drained, shallow Psammaquents (Hallandale series) are scattered throughout the area.

Potential natural vegetation: This area supports “hummock and slough” swamp vegetation. Slash pine and cabbage palm are the dominant species. Saw-palmetto, cordgrasses, and bluestems make up the understory.

V—HAWAII REGION

16,850 km² (6,510 mi²)

This region consists of eight major islands in Hawaii. These islands are of volcanic origin and consist of coastal plains, upland slopes, and mountain ranges and summits. The average annual precipitation ranges from 125 to 11,425 mm. The average annual temperature is 9 to 25°C. The growing season is throughout the year except on the mountain summits.

Ustox, Torrox, and Ustolls occur on broad coastal and upland slopes. Andepts are extensive on semiarid to very humid uplands. Humults and Humox are on old landscapes on the uplands. Aquods, Saprists, and Aquepts are on wet mountain slopes. There are large areas of lava flows and stony, rocky, and very steep land.

Sugarcane and pineapple are the major export crops. Coffee, macadamia, papaya, and floral products are other important export crops. Truck crops, mainly tomatoes, cucumbers, head cabbage, lettuce, green peppers, snap beans, bananas, and such specialty crops as ginger and taro also are important. Cattle ranching is important to the economy. The forests are used mainly for watershed, wildlife, and recreation. The pleasant climate and the tropical island scenery help make tourism an important industry.

157—Arid and Semiarid Low Mountain Slopes

1,290 km² (500 mi²)

Land use: Most of this MLRA is pasture. Small acreages of soils suited to intensive cultivation are used for irrigated truck crops. Areas that generally are unsuited to cultivation are used for urban and tourist developments.

Elevation and topography: Elevation ranges from sea level to 1,800 m. Slopes range from nearly level to moderately steep.

Climate: *Average annual precipitation*—125 to 1,025 mm. Most of the precipitation falls from October to May. *Average annual temperature*—17 to 25°C. *Average freeze-free period*—365 days.

Water: Low rainfall limits pasture production. No perennial streams are in this area. Water for livestock and irrigation is transported from other areas.

Soils: Most of the soils are Andepts and Ustolls. They are well drained, moderately deep to deep, stony to extremely stony, and medium textured. They formed in deposits of volcanic ash and have an isohyperthermic or isothermic temperature regime and an ustic or aridic moisture regime. Eutrandepts (Kikoni, Kula, Oanapuka, Pakini, Puu Pa, and Waimea series) and Dystrandepts (Pane series) are at upper elevations; Camborthids (Kawaihae series) and Haplustolls (Kamaole, Keawakapu, and Makena series) are at lower elevations.

Potential natural vegetation: This area supports grass-shrub vegetation. Kiawe, ilima, piligrass, uhaloa, buffelgrass, bermudagrass, lantana, fingergrass, cactus, Natal redtop, and Japanese tea grow on the drier sites. Kikuyugrass, white clover, rattailgrass, and guava grow on the wetter sites.

158—Semiarid and Subhumid Low Mountain Slopes

1,270 km² (490 mi²)

Land use: About 75 percent of this MLRA is cropland.

The remaining acreage is used for urban development, military installations, and other purposes. Sugarcane and pineapple are the chief crops. Small acreages are used for truck and forage crops. The soils are suited to intensive cultivation. About 75 percent of the prime farmland in the state is in this MLRA. Some soils that were formerly cultivated are now used for urban development.

Elevation and topography: Elevation ranges from sea level to 500 m. Most slopes are broad and nearly level to moderately sloping. The slopes are dissected by rocky gulches.

Climate: *Average annual precipitation*—300 to 1,525 mm in most places but as much as 2,025 mm on the Island of Kauai. Most of the precipitation falls from October to May. Summers are hot and dry. *Average annual temperature*—22 to 24°C. *Average freeze-free period*—365 days.

Water: Most of the water for irrigation comes from the abundant rainfall in the mountains, but in some places it comes from wells. Few perennial streams are in this area.

Soils: Torrox, Ustox, and Ustolls are the dominant soils. They are deep, well drained, fine textured and moderately fine textured. These soils have an isohyperthermic temperature regime, an ustic or aridic moisture regime, and kaolinitic mineralogy. The nearly level to steep Torrox (Molokai series), Haplustox (Lahaina series), Eutrustox (Lihue and Wahiawa series), and Haplustolls (Keahua, Makaweli, and Paia series) are on upland slopes.

Potential natural vegetation: This area supports grass-shrub vegetation. Lantana, bermudagrass, Natal redtop, uhaloa, ilima, kiawe, klu bush, pilgrass, cactus, fingergrass, buffelgrass, guineagrass, and koa-haole grow on the drier sites. Java-plum, pangolagrass, kikuyugrass, joe, yellow foxtail, and molassesgrass grow on the wetter sites.

159—Humid and Very Humid Low and Intermediate Mountain Slopes

2,320 km² (900 mi²)

Land use: Most of this MLRA is used for growing nonirrigated sugarcane. A small acreage is used for coffee and macadamia orchards and truck crops. The remainder is in native and introduced forests, pasture, and urban developments.

Elevation and topography: Elevation ranges from sea level to 1,800 m. Slopes are moderately sloping to steep. The area is dissected by steep-walled gulches.

Climate: *Average annual precipitation*—1,775 to 5,075 mm, but in places it is as low as 1,025 mm. Precipitation is evenly distributed in areas of high rainfall. In areas of low rainfall, 60 to 75 percent falls from October to May. *Average annual temperature*—12 to 24°C. *Average freeze-free period*—365 days.

Water: Rainfall supports most of the agriculture. Domestic water is used for supplemental irrigation of truck crops. Few perennial streams and no storage reservoirs or lakes are in this area.

Soils: Most of the soils are Andepts and Humults. They are deep, well drained, moderately fine textured and fine textured. These soils have isohyperthermic and isothermic temperature regimes and an udic moisture regime. Hydrandepts (Akaka, Hana, Hilo, Honokaa, Kailua, and Kaiwiki series) are thixotropic soils in the wetter areas, mainly along the Hamakua Coast of the Island of Hawaii. Dystrandepts (Kukaiau and Paauhau series) occur in the same area but on sites where the rainfall is less. Tropohumults having kaolinitic mineralogy (Kaneohe, Lolekaa, and Waikane series) and oxidic mineralogy (Leilehua, Paaloa, and Paumalu series) occur along the Koolau Range of Oahu on terraces, old alluvial fans, and upland slopes.

Potential natural vegetation: This area supports forest vegetation. Ohia, lehua, treefern, false-staghorn, koa, kikuyugrass, hilograss, and guava grow on the wetter sites. Java-plum, christmasberry, californiagrass, and koa-haole grow on the drier sites.

160—Subhumid and Humid Intermediate and High Mountain Slopes

910 km² (350 mi²)

Land use: This MLRA is predominantly pasture and woodland. A small acreage is used for truck crops. Most of the area is too steep and erodible for intensive farming.

Elevation and topography: Elevation is mostly 900

to 2,100 m but ranges from sea level to 2,400 m. Most of the area consists of rolling to steep mountain slopes.

Climate: *Average annual precipitation*—750 to 2,275 mm in most of the area but is as much as 3,050 mm. The rainy season is from October to May. *Average annual temperature*—12 to 23°C. *Average freeze-free period*—365 days.

Water: Domestic water comes from wells and rain catchments with storage tanks or lined reservoirs. No perennial streams are in this area.

Soils: Most of the soils are Andepts. They are deep, well drained, medium textured and moderately fine textured and have an isomesic temperature regime and an udic or ustic moisture regime. They formed in deposits of volcanic ash and are nonstony to extremely stony. The rolling to steep Dystrandepts (Hanipoe, Kaipoioi, Laumaia, Maile, Olinda, and Puu Oo series) occur on mountain slopes.

Potential natural vegetation: This area supports forest and grass-shrub vegetation. Bermudagrass, black wattle, guineagrass, and lantana grow on the drier sites. Ohia, lehua, koa, treefern, rattailgrass, kikuyugrass, orchardgrass, bromeagrass, naio, and mamani grow on the high, wetter sites.

161—Lava Flows and Rock Outcrops

7,060 km² (2,730 mi²)

Land use: A large part of this MLRA consists of bare lava flows and rock outcrops. The area extends from the lower slopes to the tops of Mauna Kea, Mauna Loa, Haleakala, Kilauea, and Hualalai volcanoes. The Hawaii Volcanoes National Park and the Haleakala National Park are in this area. Low-producing pastures and native forests are dominant in the medium rainfall belt. Some sites are cleared and used for macadamia and papaya orchards.

Elevation and topography: Elevation ranges from sea level to more than 4,000 m on mountain summits. Slopes are undulating to very steep.

Climate: *Average annual precipitation*—250 to 6,350 mm. *Average annual temperature*—9 to 24°C. *Average freeze-free period*—365 days at lower elevations. Frost occurs at higher elevations.

Water: Water sources are rain catchments and storage tanks. No perennial streams or natural lakes are in this area.

Soils: Nearly barren lava flows and rock outcrops occur in most of the area. Cinderland occurs near the mountain summits. Medium textured to coarse textured Vitrandepts (Apakuie, Huikau, and Kilohana series), which have an isomesic temperature regime, formed in deposits of volcanic ash and cinders at higher elevations.

Potential natural vegetation: This area supports forest and shrub vegetation. Kiawe, klu bush, pilgrass, and ilima grow on the drier sites. Ohia, lehua,

pukiawe, naio, mamani, Kentucky bluegrass, sweet vernalgrass, guava, and molassesgrass grow on the wetter sites.

162—Very Humid Areas on East and West Maui Mountains, Kohala Mountains, and Mount Waialeale

590 km² (230 mi²)

Land use: This MLRA consists of heavily vegetated native rain forests used mainly for watershed and wildlife. Most sites are not easily accessible.

Elevation and topography: Elevation ranges from sea level to 1,800 m. The moderately sloping to steep landscape is dissected by many steep-sided gulches.

Climate: *Average annual precipitation*—2,025 to 11,425 mm. Fog and cloud cover occur almost daily; there is no dry season. *Average annual temperature*—13 to 24°C. *Average freeze-free period*—365 days.

Water: Water is supplied to other MLRA's for irrigation and domestic uses. Many perennial streams are in this area.

Soils: The dominant soils are Aquods, Sapristis, Aquepts, and Andepts. They are shallow to deep and have a high content of organic matter. These soils have an isomesic temperature regime and an udic and aquic moisture regime. Somewhat poorly drained Tropaquods (Waialeale series) and very poorly drained Tropo-sapristis (Alakai series) are near the mountain summit of Kauai. Poorly drained and somewhat poorly drained Placaquepts (Amalu and Kahua series) and somewhat poorly drained Andaquepts (Kehena series) are in the Hohala Mountains on the Island of Hawaii. Moderately well drained to well drained Hydrandepts and somewhat poorly drained Tropaquods occur on Maui.

Potential natural vegetation: This area supports rain forest vegetation. Kikuyugrass, hilograss, sedges, guava, ohia, lehua, pukiawe, ohelo, koa, treefern, false-staghorn, uki uki, pamakani, and ricegrass commonly grow.

163—Alluvial Fans and Coastal Plains

320 km² (120 mi²)

Land use: About 70 percent of this MLRA is used for urban developments and military installations. A small acreage is used for truck crops and the remainder for irrigated sugarcane.

Elevation and topography: Elevation is from sea level to 100 m but ranges to 200 m. The area consists of nearly level to moderately sloping alluvial fans and coastal plains.

Climate: *Average annual precipitation*—250 to 750 mm. Most of the precipitation falls from October to May. *Average annual temperature*—23 to 24°C. *Average freeze-free period*—365 days.

Water: There are few perennial streams. In many places, wells provide suitable water for domestic use

and for irrigation. Some wells provide brackish water suitable only for irrigation. Additional water is obtained from the abundant rainfall in the mountains.

Soils: Most of the soils are Ustolls. They are deep, well drained, nonstony to stony, and fine textured to coarse textured. These soils have an isohyperthermic temperature regime and an ustic moisture regime. Haplustolls (Ewa, Kekaha, Mamala, Nohili series), which have kaolinitic, montmorillonitic, or mixed mineralogy, occur on alluvial fans and on coastal plains. Excessively drained Ustipsamments (Jaucas series) formed in coral sand along the coastal fringe. Chromusterts (Lualualei series) are on talus slopes and alluvial fans.

Potential natural vegetation: This area supports grass and shrub vegetation. Bermudagrass, fingergrass, bristly foxtail, sandbur, lantana, kiawe, koa-haole, and klu bush are dominant.

164—Rough Mountainous Lands

1,100 km² (430 mi²)

Land use: Most of this MLRA consists of steep to precipitous mountain slopes and gulches. The upper elevations are heavily vegetated native rain forests. Watershed and wildlife habitat are the principal land uses. A small acreage of the low and intermediate slopes is used for pasture.

Elevation and topography: Elevation ranges from sea level to 1,500 m. Topography is steep to precipitous; many steep-sided gulches dissect the area. Local relief ranges from about 100 m to more than 300 m.

Climate: *Average annual precipitation*—Mostly 1,900 to 6,350 mm, but ranges from 750 to 11,425 mm. *Average annual temperature*—13 to 23°C. *Average freeze-free period*—365 days.

Water: Much of the water for irrigation and for domestic use in the region is supplied from this MLRA. Many perennial and intermittent streams are in this area.

Soils: Rough broken land, rough mountainous land, and rock outcrop are among the land types occurring in most of this area. Inextensive, poorly drained, gently sloping to hilly Placaquepts (Amalu and Olokui series) are in areas at higher elevations on Molokai.

Potential natural vegetation: This area supports forest and shrub vegetation. Ohia, lehua, false-staghorn, koa, treefern, hilograss, lapalapa, Java-plum, and sedges grow on sites having abundant rainfall. Kiawe, koa-haole, and fingergrass grow on the drier sites.

165—Subhumid Intermediate Mountain Slopes

300 km² (110 mi²)

Land use: This MLRA is used mainly for pasture, woodland, and wildlife habitat. In recent years woodland plantings of eucalyptus and pines have been

made on Kauai and on Molokai. Most of the area on Oahu is very steep and inaccessible.

Elevation and topography: Elevation ranges from 200 to 1,300 m. Most of the area is steep to very steep and is broken by numerous drainageways. Locally, sites are gently sloping to moderately sloping.

Climate: *Average annual precipitation*—750 to 1,900 mm. The rainy period generally is from October to May. *Average annual temperature*—13 to 22°C. *Average freeze-free period*—365 days.

Water: There are no perennial streams. Water for livestock and other uses is supplied from other MLRA's.

Soils: This area consists of rough broken land and deep to moderately deep, well drained, medium textured to fine textured Humults, Humox, and Andepts. They have an isothermic temperature regime. Tropohumults (Kalae and Kokee series) formed in deposits of basic igneous rock and have oxidic mineralogy. Acrohumox (Kahanui and Mahana series) formed in deposits of basic igneous rock or volcanic ash and have ferritic or kaolinitic mineralogy. Dystrandepts (Oli series) formed in deposits of volcanic ash.

Potential natural vegetation: This area supports forest vegetation. Lantana, Natal redtop, bermudagrass, fingergrass, kiawe, and koa-haole grow on the drier sites. Guava, mossassesgrass, aalii, joe, yellow foxtail, ohia, lehua, koa, silver oak, pukiawe, ricegrass, and Bostonfern grow on the wetter sites.

166—Very Stony Land and Rock Land

1,250 km² (480 mi²)

Land use: Most of this MLRA is used for pasture or for wildlife. The pastures have a low carrying capacity. Small acreages on the wet sites are in native or planted forest vegetation.

Elevation and topography: Elevation generally ranges from sea level to 900 m, but it is as high as 2,400 m on Maui. The landscape is sloping to steep and is dissected by many drainageways. Some sites are precipitous.

Climate: *Average annual precipitation*—250 to 1,525 mm. Most of the precipitation falls from October to May. *Average annual temperature*—19 to 24°C.

Average freeze-free period—365 days except at the highest elevations.

Water: In this area, there are no perennial streams or natural storage.

Soils: Most of the area is very shallow and stony or rocky. Very stony land, rock land, rough mountainous land, and rock outcrop are the dominant land types.

Potential natural vegetation: Sites having a soil mantle support forest or grass-shrub vegetation. Buffelgrass, lantana, pilgrass, klu bush, Natal redtop, and kiawe grow on the drier sites. Guava, aalii, ohia, lehua, and pukiawe grow on the wetter sites.

167—Humid Low and Intermediate Mountain Slopes

440 km² (170 mi²)

Land use: This MLRA is used for growing pineapple on Maui and sugarcane on Kauai. It is also used for pasture, woodland, and wildlife habitat.

Elevation and topography: Elevation ranges from sea level to 500 m. The nearly level to very steep landscape is dissected by many steep-sided drainageways.

Climate: *Average annual precipitation*—1,275 to 5,075 mm. *Average annual temperature*—21 to 24°C. *Average freeze-free period*—365 days.

Water: In this MLRA, there are a few perennial streams but no natural storage.

Soils: Most of the soils are Humults and Orthox. They are deep, well drained, and fine textured. These soils have an isohyperthermic temperature regime and oxidic or ferritic mineralogy. The gently sloping to moderately steep Tropohumults (Haiku and Pauwela series) occupy slopes on the windward side of east Maui. Gibbsiorthox (Kapaa and Pooku series) and Umbriorthox (Makapili series) are on the top of broad ridges on uplands of Kauai. Poorly drained Fluvaquents (Hanalei series) occur along drainageways.

Potential natural vegetation: This area supports californiagrass, christmasberry, hilograss, ricegrass, Malabar melastome, rhodomyrtus, yellow foxtail, false-staghorn, pangolagrass, kikuyugrass, kaimi clover, sensitive plant, Java-plum, and joe.

W—SOUTHERN ALASKA REGION

321,090 km² (123,970 mi²)

This region consists of mountains, forests, a large intermontane lowland, and islands bordering the Pacific Ocean. The higher parts of the mountains have a permanent ice cover. The eastern and central parts of the region are forested at lower elevations. In the west, grassland and tundra are dominant. The average annual precipitation is 1,275 to 2,550 mm. It ranges from 375 to 625 mm in the Cook Inlet-Susitna Lowland to more than 5,075 mm in the southeastern part of the region. The average annual temperature is 0 to 7°C at lower elevations. Soils in inland basins are the only soils that freeze deeply.

Stony Cryorthods are the dominant soils in the eastern and central parts of the region. Associated with them are Histosols on lower slopes, in depressions, and in areas above timberline. Cryaquents and Cryaquepts are on outwash plains and on flood plains. Cryofluvents occupy the higher parts of the flood plains. Cryandepts are dominant in the western part of the region, where most soils formed in deposits of volcanic ash. The highest mountains have no soil cover.

Farmland is largely on level to sloping soils in the Cook Inlet-Susitna Lowland. Grasses, small grains, potatoes, and other vegetables are the principal crops. Timber production is important in the eastern and central parts of the region. Some natural grasslands on islands in the west are grazed by cattle and sheep. Hunting and other forms of recreation are important in most of the region.

168—Southeastern Alaska

86,490 km² (33,390 mi²)

Land use: Most of this MLRA is forested. Logging is an important industry. Land at elevations of 500 m or more, including the ice-covered Coast Mountains, is valuable mainly for recreation. There is virtually no farming. The population is almost entirely in small coastal cities and in villages, where commercial fishing is the important industry. Because of the general steepness of the terrain, landslides and gullying are severe hazards on soils that have been cleared and logged.

Elevation and topography: Elevation ranges from sea level to more than 2,400 m in the Coast Mountains. On the islands, which make up most of the area, only a few peaks are higher than 1,500 m. Long narrow bays carved into the mountains by glaciers create extremely irregular coastlines on both the mainland and the islands. Most of the bays have narrow borders of hilly moraines, and at the head, short flat-bottomed valleys. Most slopes throughout the area are very steep.

Climate: *Average annual precipitation*—1,275 to 2,550 mm. Precipitation is mostly snow at the higher elevations, with accumulations of 600 cm or more at elevations above 500 m. *Average annual temperature*—4 to 8°C. *Average freeze-free period*—200 to 210 days, but the long seasons are offset by low temperatures in summer and persistent cloud cover.

Water: The area has abundant precipitation and many small lakes and streams. Well drained soils generally are close to the saturation point, and many soils are always wet.

Soils: The dominant soils are Orthods. They have a cryic temperature regime and an udic moisture re-

gime. Cryorthods (Kupreanof and Tolstoi series), on steep slopes, generally are very stony or shallow over bedrock and are strongly thixotropic. Cryohumods (Sitka series) are in areas with thick deposits of volcanic ash. Fragiorthods (Karta series) and Fragiaguods (Wadleigh series) formed over compact glacial till. Poorly drained Histosols, including Cryosaprists (Maybeso series), Cryohemists (Kina series), Cryofibrists (Staney series), and Sphagnofibrists (Kogish series) are abundant on foot slopes and on higher slopes affected by seepage, in parts of valley bottoms, and in most areas immediately above tree line. Cryofolists (McGilvery series) occur over bedrock outcrop in association with Cryorthods. Sandy Cryaquents (Stave series) are common in glacial outwash plains, usually in association with Sphagnofibrists, and in valley bottoms. Steep mountains having no soil cover make up more than 40 percent of the area.

Potential natural vegetation: At elevations below 500 m, coniferous forest vegetation is dominant. Western hemlock, Sitka spruce, and (in the southernmost part of the area) Alaska-cedar are dominant species. Sedges, mosses, and other plants adapted to wet soil conditions cover most of the area immediately above tree line and occupy many drainageways and slopes subject to seepage.

169—South-Central Alaska Mountains

98,080 km² (37,870 mi²)

Land use: Recreation is the most important land use in this MLRA. A few sites are used for commercial forestry. The area is sparsely inhabited except in several small coastal cities that serve as ports and as centers for commercial fishing, the principal industry. Farming is of no commercial importance.

Elevation and topography: Elevation ranges from sea level to more than 4,900 m. Included in this area are the St. Elias, Chugach, and Kenai Mountains bordering the Gulf of Alaska and the Wrangell and Talkeetna Mountains further inland. Icefields and glaciers cover the higher parts of the mountains. Several large coastal lowlands, consisting of glacial outwash and tidal deposits, are between the coastal mountains and the sea. High dunes are common along the coast and in areas bordering large rivers.

Climate: *Average annual precipitation*—2,025 to more than 4,325 mm along the coast, but on the north slopes of the Talkeetna and Wrangell Mountains it is as little as 325 mm. Annual snowfall at sea level ranges from 250 to 630 cm bordering Prince William Sound, 130 cm at low elevations inland, and much deeper in the coastal mountains. *Average annual temperature*—About -7 to -1°C in the mountains. *Average freeze-free period*—170 to 205 days along the coasts and about 100 days inland.

Water: Small lakes and streams are abundant in this area. In general, ground water is at a shallow depth in the coastal areas but is less available inland. Much water exists in the form of glacial ice in the higher parts of the mountains.

Soils: Icefields and bare rock or rubble make up about 70 percent of the area. The dominant soils are Umbrepts and Ochrepts. They have a pergelic temperature regime above the tree line and a cryic temperature regime below. Gravelly Cryumbrepts and Cryochrepts are associated with Cryaquepts in vegetated parts of the inland mountains. On vegetated uplands in coastal regions, under both forest and tundra vegetation, Cryorthods (Kupreanoff and Kniklik series) and Cryohemists (Kina and Unakwik series) are extensive. On the coastal lowland, Cryaquents and associated Histosols are dominant. Cryorthents and Cryopsamments are the principal soils of dunes.

Potential natural vegetation: Forest vegetation dominated by western hemlock and Sitka spruce fringe most of the Gulf coast. Sedges, mosses, and other water-tolerant plants grow on most sites immediately above tree line in the coastal mountains and on many sites with poor drainage in the forested zone. In places, especially in parts of the Kenai and Talkeetna Mountains bordering the Cook Inlet-Susitna Lowland, the vegetation in a zone immediately above tree line consists principally of grasses, forbs, and willows. Low-growing alpine tundra vegetation grows in still higher areas. In mountains bordering the Copper River Plateau, forests of black spruce, dwarf birch, and willows grow at elevations ranging to about 900 m, where they give way to the low-growing alpine vegetation. The broad coastal lowlands included in the area are mostly marshy, but forests of hemlock and Sitka spruce are on terraces, stabilized dunes, and beach ridges.

170—Cook Inlet-Susitna Lowland

43,080 km² (16,630 mi²)

Land use: Included in this MLRA are more than two-thirds of the operating farms in Alaska and the largest urban complex in the state. More than 80 percent of the area, however, is still in forest or natural grassland used principally for recreation. Grasses, small grains, potatoes, and many vegetables are the principal crops. Logging is important locally. Rapid growth of the Anchorage urban area is impinging on nearby farmland.

Elevation and topography: Elevation is mostly below 200 m, but it is 900 m in the south and in the foothills of surrounding mountains. The long, comparatively narrow basin is surrounded by mountains except at the mouth of Cook Inlet, which opens into the Gulf of Alaska. The land surface consists principally of glacial deposits: low moraines, interspersed with many lakes and bogs, and broad outwash plains and terraces. The underlying sediments are at the surface only in parts of the south.

Climate: *Average annual precipitation*—500 to 625 mm in the south, decreasing to 375 to 500 mm in the central part. Most precipitation falls late in summer and early in autumn. The average annual snowfall is 130 to 170 cm. *Average annual temperature*—0 to 3°C . *Average freeze-free period*—110 to 150 days.

Water: Perennial streams and lakes provide abundant water in most of the area, but soils on drier sites, such as in the Matanuska Valley, are often deficient in moisture in midsummer. In some places, ground water is obtainable only at great depth.

Soils: The principal upland soils are Orthods. They have a cryic temperature regime. Cryorthods (Rabideux and Naptowne series) formed in a shallow to moderately deep mantle of loess and volcanic ash over glacial deposits. Cryandepts (Kachemak and Island series) are in some of the southern parts of the area. Cryorthents (Bodenburg and Knik series) are on sites having recent deposits of loess. Borofibrists (Salamatof series) and Borohemists (Doroshin and Starichkof series) occupy many depressions. Cryofluvents (Susitna series) are on flood plains. Sandy Cryaquents are in large outwash plains and on flood plains immediately below mountain glaciers.

Potential natural vegetation: This area supports forest vegetation. White spruce, paper birch, and, in some places, quaking aspen are dominant species. Balsam poplar is common on soils bordering the principal streams and Cook Inlet. Sitka spruce and hemlock are major species in the southernmost part of the lowland. Black spruce is the principal species on wetter soils and on some well drained sites that have been burned repeatedly. Most muskegs (bogs) are treeless or support stands of stunted black spruce.

171—Alaska Peninsula and Southwestern Islands

93,440 km² (36,080 mi²)

Land use: Most of this MLRA is largely undisturbed. A few small sites are mined, and some parts of the Kodiak Island group and the eastern Aleutian Islands are grazed by cattle and sheep. Commercial fishing is the principal industry in all towns and villages in this area. Many large military bases on Kodiak Island and the Aleutian Islands are abandoned.

Elevation and topography: Elevation ranges from sea level to more than 3,400 m; the highest peaks are in the north. The area is mostly mountainous or hilly. Most of the mountains, except those in the Kodiak Island group, are of volcanic origin. Peaks higher than about 1,800 m have a perennial ice cover and glaciers commonly flow down their sides.

Climate: *Average annual precipitation*—375 to 625 mm on western slopes of mountains in the north and more than 1,775 mm on the Aleutian Islands. The annual snowfall is 75 to 215 cm, but snow does not persist throughout the winter except in the north and on high mountains. *Average annual temperature*—0°C in the north to 4°C in the Aleutian Islands. *Average freeze-free period*—130 days in the north (at lower elevations) to 250 days in the Aleutian Islands.

Water: Water is abundant throughout the year. Lakes and streams make up more than 3 percent of the area. They freeze in winter in the north but do not freeze in the south or in the west.

Soils: About 30 percent of the area consists of high mountains with no soil cover. The dominant soils are Andepts. They have a cryic temperature regime. Cryandepts (Kodiak and Umnak series) are on the better drained sites. Cryofibrists (Saltery series) occupy depressions and some seep areas. Fresh cinder flows are on slopes of active volcanoes.

Potential natural vegetation: Forests of Sitka spruce occupy coastal areas in the northern part of the Kodiak Island group and in the northeastern part of the Alaska Peninsula. Foothills and moraines elsewhere in the Kodiak Island group and on the Pacific Ocean side of the Alaska Peninsula have a dense stand of grasses (dominantly bluejoint reedgrass), alder, and other forbs and shrubs. Low shrubby vegetation grows on the lowlands on the Alaska Peninsula bordering the Bering Sea, as well as on other lowlands and ridges exposed to strong winds. Grasses and forbs with no large shrubs grow on many of the low rolling hills on the Aleutian Islands. High mountains in the area have only glaciers or bare rock and cinders.

X—INTERIOR ALASKA REGION

659,970 km² (254,820 mi²)

This subarctic region consists of mountains, hills, and lowlands. Although the highest mountains in North America are in this region, most of the land consists of maturely dissected hills and broad basins and valleys. Forests cover the area below an elevation of about 1,000 m, and alpine tundra mantles higher ridges. The average annual precipitation is 200 to 500 mm in most of the region, but it is much higher in the Alaska Range and in mountains north of Bristol Bay. The average annual temperature ranges from about -12°C in the north to about -10°C in the south, but it is generally higher than -7°C. The freeze-free period ranges from 75 to 110 days at elevations less than 500 m.

The most extensive soils in this region are Cryaquepts, which are underlain by permafrost. They are in depressions, on most lower slopes, on north-facing slopes, and in most areas of high elevation. The well drained Cryochrepts are dominant on forested sites where annual precipitation is less than 375 mm. Cryorthods are dominant on forested sites where precipitation is more than 375 mm. Forested Cryofluvents are on flood plains. Shallow Cryumbrepts, Cryorthods, and Cryorthents commonly occur in the zone of alpine tundra.

Subsistence hunting and fishing are the principal economic uses of the soils in this region. Farming is confined largely to the Tanana Valley, but several other parts of the region have good potential for agriculture. Grasses, small grains, potatoes, and other vegetables are the principal crops. Timber is harvested in the Tanana Valley and in a few other places for local use.

172—Copper River Plateau

37,910 km² (14,640 mi²)

Land use: This MLRA is used principally for recreation, including hunting. A few farms are along the Copper River. Grasses, small grains, and vegetables, including potatoes, are the principal crops. A few small acreages have been logged. The permanent population is small. Most income is derived from services associated with major highways that traverse the area.

Elevation and topography: Elevation is mainly 500 to 900 m, but it is as much as 1,200 m in foothills of the surrounding mountains and as low as 300 m on flood plains of the Copper and Chitina Rivers. The area is a broad basin of rolling to hilly moraines, glacial lacustrine sediments, and alluvial plains. It is completely surrounded by mountains but is drained by the Yukon drainage system and by major rivers flowing to the Gulf of Alaska.

Climate: *Average annual precipitation*—225 to 400 mm. Most of the precipitation falls in summer. *Snow accumulation* is 62 to 90 cm in winter. *Average annual temperature*—About -4 to 0°C.

Water: The soils in this area except for those at lower elevations are underlain by permafrost. The soils above perennially frozen ground are wet or moist throughout the summer. Soils on cleared sites are commonly deficient in moisture. Many small lakes and ponds are in this area. Most of the usable ground water is deep and difficult to obtain.

Soils: The dominant soils are Aquepts, which have a pergelic temperature regime and an aquic moisture regime. Cryaquepts (Klawasi and Deborah series), which are underlain by permafrost, are dominant at an elevation of about 600 m to the tree line at about 900 m. Gravelly and stony Cryochrepts (Cheshina

and Gulkana series) commonly occur at lower elevations. Thin Cryorthods and Cryumbrepts, over deep permafrost, and Cryaquepts, which are shallow to permafrost, are dominant above the tree line.

Potential natural vegetation: Most of the area below an elevation of 900 m supports forest vegetation. Black spruce, willows, and dwarf birch are dominant species. Burned-over forests of white spruce, paper birch, and quaking aspen are at lower elevations along the Copper and Chitina Rivers and on a few steep south-facing slopes at higher elevations. Low-growing alpine shrubs, grasses, and sedges are dominant at elevations above 900 m.

173—Alaska Range

70,500 km² (27,220 mi²)

Land use: This MLRA is largely undisturbed. Two main roads and a railroad traverse low passes in the Alaska Range. These transportation lines and the tourist sections in Mt. McKinley National Park are the only parts of the area that are intensively used. There are also a few small mines and hunting lodges, and horses maintained by guides graze on some natural grassland. There is no farming or commercial forestry.

Elevation and topography: Elevation is mainly 900 to 3,000 m. The area consists of rugged mountains with many peaks higher than 3,100 m and includes Mt. McKinley, the highest peak (6,200 m) in North America. Nearly all the area is above tree line; higher parts of the mountains are perennially ice covered. The transition from the rugged mountains to adjoining lowlands is generally sharp.

Climate: *Average annual precipitation*—About 250 mm on northern and western slopes on the mountains and about 625 to 1,275 mm on the southern and

southeastern slopes. The average annual snowfall is less than 190 cm on the northern and western slopes and more than 250 cm on the southern and southeastern slopes. *Average annual temperature*—less than -7°C at high elevations and -6 to -2°C in low passes.

Water: Many streams and rivers originate in the mountains, and many carry heavy loads of glacial silt.

Soils: The dominant soils are Aquepts, Orthods, Umbrepts, and Ochrepts. These soils have a pergelic or cryic temperature regime. About two-thirds of the area has no soil. Cryaquepts, shallow to permafrost, and shallow stony Cryorthods, Cryumbrepts, and Cryochrepts, underlain by deeper permafrost, are on the lower slopes and in the passes.

Potential natural vegetation: This area supports shrubby alpine vegetation on most lower slopes. Black spruce forests and natural grasslands also occur. Most of the high steep slopes have no vegetation.

174—Interior Alaska Lowlands

161,490 km² (62,350 mi²)

Land use: Many towns and villages, including Fairbanks the commercial center of northern Alaska, are along major rivers. The remainder of the area is little used other than for subsistence hunting and fishing. Much of the potential farmland of the state is in this MLRA, but farming is largely confined to the Tanana Valley in the vicinity of Fairbanks and Delta Junction. Grasses, small grains, potatoes, and other vegetables are the principal crops. Some dairy and beef cattle and hogs are raised. Logging is important locally. Marshy lowlands in the area are important breeding grounds for waterfowl. Urban growth, particularly in the Fairbanks area, is taking place at the expense of agricultural land. Flooding is a severe hazard in most settlements.

Elevation and topography: Elevation ranges from about 25 m along the lower Yukon River to about 600 m in the upper Tanana Valley. The broad valleys and basins are nearly level, but there are also some low rolling hills and piedmont slopes.

Climate: *Average annual precipitation*—Generally 250 to 500 mm, but it is 150 to 250 mm in the Yukon Flats. Maximum precipitation is late in summer. The average annual snowfall is about 120 cm. *Average annual temperature*—About -7°C in the north to -4°C in the south. *Average freeze-free period*—70 to 120 days.

Water: Surface water in streams, lakes, and bogs is abundant in most of the area. In most years, however, well drained soils are deficient in moisture in midsummer. Ground water under such soils is usually abundant but in some places may be difficult to obtain because of permafrost. All poorly drained soils are underlain by perennially frozen ground.

Soils: The dominant soils are Aquepts, which have a

pergelic temperature regime and an aquic moisture regime. Cryaquepts (Goldstream and Kuskokwim series), which are underlain by permafrost, are associated with less extensive Cryofibrists (Lemeta series). Cryofluvents (Salchaket and Takotna series) occur in well drained areas of broad flood plains. Well drained, silty Cryochrepts and Cryorthents are on terraces, mostly in the Yukon Flats.

Potential natural vegetation: Mosses, sedges, shrubs, and stunted black spruce grow on soils having impeded drainage. Forests of white spruce, paper birch, quaking aspen, and cottonwood (balsam poplar) grow on well drained soils. The higher parts of piedmont slopes adjacent to mountains support an alpine tundra vegetation.

175—Kuskokwim Highlands

175,510 km² (67,770 mi²)

Land use: The sparse population of this MLRA is concentrated in small villages on the coast and along major rivers, where commercial fishing is the major industry. The remainder of the area is little used except for subsistence and sport hunting and fishing. Many towns in which mining was formerly a major industry are deserted or are occupied only during the summer. A few mines, however, are still active. Little use is made of the forests, and there is virtually no farming.

Elevation and topography: Elevation ranges from 500 to 600 m on ridges in the north to 1,500 m in the south. The area includes hills and low mountains between the central Yukon River and Bristol Bay. Deep narrow valleys separate the ridges in the north. Rugged mountains, long narrow lakes, and rolling to steep hills are in the south. Much of the south exhibits glacial features, but in the north only the higher peaks were covered by glaciers.

Climate: *Average annual precipitation*—300 mm in the north to 625 to 1,025 mm on the coast. Precipitation is heaviest late in summer. The average annual snowfall ranges from about 150 cm in the north to 200 cm in the south. *Average annual temperature*—About -7°C in the north to about -1°C in the south. *Average freeze-free period*—90 to 110 days.

Water: Water is adequate for vegetation in the central and southern parts. Soils in the north are often deficient in moisture in midsummer. Surface water is abundant in the south. The glacially carved Tikchik and Wood River Lakes are a conspicuous feature in the southern mountains. Permafrost exists in most low-lying soils and in high mountains, but it is generally absent in soils covered by forests or by grasses and alder.

Soils: The dominant soils are Aquepts, which have a pergelic temperature regime and an aquic moisture regime. Cryaquepts (Kuskokwim and Kuslina series), which are underlain by permafrost, are on the most extensive black spruce sites. The dominant soils

under white spruce-paper birch forest and grass-alder vegetation are Cryohumods (Nondalton series) and Cryorthods (McGrath and Aleknagik series). Cryochrepts (Hughes and Koyukuk series) support forest vegetation in the north, and Cryandeps (Kvichak series) support shrubby vegetation in the south.

Potential natural vegetation: Black spruce forest vegetation is dominant in this area. Many hills and ridges, however, support only tundra vegetation consisting of sedges and shrubs. Forests of white spruce and paper birch are on hills bordering the Yukon and Kuskokwim Rivers, other major rivers, and Bristol Bay. A dense stand of grasses and alder covers the hills bordering the Wood River-Tikchik Lakes and Togiak Bay.

176—Interior Alaska Highlands

214,560 km² (82,840 mi²)

Land use: Most of this MLRA is used only for subsistence and sport hunting and, to a limited extent, for other recreation. Farms were formerly in several places along the Yukon River, but farming is now largely confined to the area near Fairbanks. Grasses, small grains, potatoes, and other vegetables are principal crops. Mining was once a major industry, with placer claims on many streams, but relatively few active mines remain.

Elevation and topography: Elevation is less than 330 to 1,800 m. The area consists mostly of low mountains and hills interrupted by many flat-bottomed valleys. Slopes are generally steep. Only the highest mountains were covered by glaciers.

Climate: *Average annual precipitation*—250 to 375 mm. Maximum rainfall is late in summer. The average annual snowfall ranges from 120 to 250 cm.

Average annual temperature—About −12 to −9°C in the north and −7 to −4°C at lower elevations in the south.

Water: Many streams traverse the area, and a few lakes are in the broader valleys, but many extensive hilly sections have little surface water. Well drained soils usually are deficient in moisture in midsummer. Most valley bottoms, north-facing slopes, and hills at an elevation above 800 m are underlain by permafrost. Soils above the perennially frozen ground are usually wet or moist.

Soils: The dominant soils are Ochrepts and Aquepts. These soils have a cryic or pergelic temperature regime. The principal soils under white spruce-birch-aspen forests on uplands are Cryochrepts (Fairbanks and Hughes series). Soils under black spruce forest and tundra vegetation characterized by sedges are Cryaquepts, underlain by shallow permafrost (Saulich and Kuskokwim series) or by deep or sporadic permafrost (Minto and Fairplay series). Shallow stony Cryochrepts, Cryumbrepts, Cryorthents, and Cryorthods are in alpine areas with tundra vegetation characterized by sparse shrubby plants.

Potential natural vegetation: The vegetation pattern in the area is complex. Forests of white spruce, paper birch, and quaking aspen cover most lower slopes in the south and south-facing slopes in the north. Black spruce forest vegetation grows at higher elevations, on all north-facing slopes in the south, on all but steep south-facing slopes in the north, and on lower slopes with impeded soil drainage throughout the area. Above the black spruce forests, the vegetation is alpine tundra characterized by sedges on poorly drained sites and by low-growing shrubs on drier sites.

Y—ARCTIC AND WESTERN ALASKA REGION

505,510 km² (195,180 mi²)

This region consists of mountains, foothills, and extensive coastal plains and deltas. Most of this region is covered by tundra vegetation, but there are a few forested areas, mostly at the southern and eastern margins. The average annual precipitation is 125 to 300 mm in the Arctic and 250 to 500 mm in the western part of the region. The average annual temperature ranges from -12°C in the north to 0°C in the southwest.

Cryaquepts, which are underlain by permafrost, are the dominant soils in this region. In places, Cryaquolls and Cryofibrists are associated with Cryaquepts. Cryumbrepts, Cryoborolls, and Cryorthents are on high ridges and on other sites where surface drainage is good. Cryopsamments occur on dunes in the Arctic and on the coasts. All have perennially frozen substrata. Permafrost is deep or absent in Cryofluvents on flood plains in western Alaska, Cryandepts in the extreme southwest, and Cryochrepts and Cryorthods of the forested inland margins.

Most of the land in this region is used only for subsistence hunting and fishing. Commercial fishing is the principal industry in settlements along the coasts and the major rivers in western Alaska. Several reindeer herds graze on the tundra range in western Alaska. There is no commercial farming or forestry.

177—Norton Sound Highlands

114,960 km² (44,390 mi²)

Land use: Except in the vicinity of villages and small cities on the coasts and along the Yukon River, this MLRA is little used. Commercial fishing and subsistence hunting and fishing are the principal occupations. Mining, formerly a major source of income, is now much less important. Several small reindeer herds graze the tundra vegetation that covers most of the area. Forests along the western boundary and bordering Norton Bay are not used commercially. There is no farming.

Elevation and topography: Elevation generally ranges from sea level to 900 m, but a few peaks are at an elevation of 1,200 m. The area consists principally of steeply sloping hills and low mountains. Some mountainous locations on the Seward Peninsula were glaciated, but most of the area has never had a permanent ice cover. Several lava flows and low ancient volcanic cones are in this area.

Climate: *Average annual precipitation*—Less than 250 mm to about 450 mm. The annual snowfall is 75 to 190 cm. *Average annual temperature*—About -7°C in the north and between -4 and -1°C in the south.

Water: Streams are in nearly all the larger valleys. There are many inland lakes on the Seward Peninsula and many small lakes and ponds on included coastal plains, especially in the extreme northwest. Most of the area, except for forests bordering the Yukon River, is underlain by permafrost.

Soils: The dominant soils are Aquepts, which have a pergelic temperature regime. Cryaquepts (Kuskokwim and Nome series), which are underlain by permafrost, are on the extensive sites having impeded drainage. The principal soils on high ridges and in other areas where surface drainage is good are the gravelly or stony Cryumbrepts (Aniak series). Cryoborolls and Cryorthents also occupy these posi-

tions. Silty Cryorthods (Whitsol series) and Cryochrepts (Koyukuk series) border the Yukon River.

Potential natural vegetation: Most of this area supports tundra shrubs and sedges. Forests of white spruce and paper birch grow in a narrow strip on the eastern edge of the highlands, bordering the Yukon River. Black spruce forests cover the lower slopes of many inland valleys. Acreages of mixed forests are northeast of Norton Sound. High ridges are very sparsely vegetated.

178—Western Alaska Coastal Plains and Deltas

80,510 km² (31,080 mi²)

Land use: Parts of this MLRA provide important breeding ground for waterfowl. The remainder is little used. A few reindeer herds graze in the area, and there is much subsistence hunting. Commercial and subsistence fishing is the principal occupation in towns and villages along the major rivers. There is no commercial farming, and the few forests in the area are not used commercially.

Elevation and topography: This is an area of low elevation, with very little relief. The ground surface, however, has an irregular microrelief, and many lakes and ponds are connected by a maze of waterways. A few isolated rocky hills are in the area, and low sand dunes are common.

Climate: *Average annual precipitation*—Less than 250 mm in the Selawik-Kobuk Delta to about 500 mm in the Bristol Bay coastal plain. The average annual snowfall is 120 to 190 cm throughout the area. *Average annual temperature*—About -7°C in the north to more than 0°C in the south.

Water: Lakes and ponds make up 15 to 20 percent of the area. Permafrost underlies nearly all areas except the southern part of the Bristol Bay coastal plain. Soils underlain by permafrost are nearly al-

ways saturated in summer. In natural levees and in sand dunes, permafrost is deep or absent, and the soils are well drained. Spring flooding along rivers and tidal inundation along the coasts are common.

Soils: The dominant soils are Aquepts, which have a pergelic temperature regime. Cryaquepts (Kuskokwim and Tupuknuk series), which are underlain by shallow permafrost, occupy nearly all of the area. Cryofluvents (Takotna series) are on natural levees along major streams. Sandy Cryandepts (Pustoi series) are on low dunes in the Bristol Bay coastal plain.

Potential natural vegetation: This area supports tundra vegetation. Mosses, sedges, and low-growing shrubs cover most of the area. Alder and willows and, in a few places, stunted spruce and paper birch grow along the major streams. Grasses grow on dunes along the coasts.

179—Bering Sea Islands

12,350 km² (4,770 mi²)

Land use: Fishing and hunting of sea mammals are the major sources of income in this MLRA. On Nunivak Island, reindeer are harvested commercially and a herd of musk ox is maintained. The annual harvest of fur seals on the Pribilof Islands is the major industry. Reindeer live on most of the other islands, but most of them are wild. There are no forests on the islands, and there is no farming.

Elevation and topography: Elevation ranges from sea level to 600 m. The islands, except for parts of St. Lawrence and Nelson Islands, consist mostly of volcanic rock. Relief ranges from nearly level to hilly. Many dormant volcanic cones exist, but only the one on St. Lawrence Island attains an elevation greater than 600 m.

Climate: *Average annual precipitation*—Less than 250 mm to more than 750 mm. Precipitation is greater on the windward sides of hills. The annual snowfall ranges from 120 to 200 cm. *Average annual temperature*—About -4°C on St. Lawrence Island to 2°C on the Pribilof Islands. All but the Pribilof Islands are icebound in winter.

Water: Streams and ponds are abundant on the islands. Most soils, except for those shallow to bedrock, are underlain by permafrost and are wet throughout the summer. There is no permafrost, however, on the Pribilof Islands.

Soils: The dominant soils are Aquepts and Aquolls, which have a pergelic temperature regime. Shallow, gravelly Cryaquepts and Cryaquolls, which are underlain by permafrost, occupy extensive areas where drainage is restricted. Cryofibrists (Inmachuk series) are in depressions. Gravelly Cryumbrepts and Cryoborolls are dominant on ridges and on other sites where surface drainage is good. Cryandepts are on better drained sites on the Pribilof Islands.

Potential natural vegetation: Tundra vegetation,

consisting principally of mosses, sedges, and low-growing shrubs, covers the entire area.

180—Brooks Range

107,470 km² (41,490 mi²)

Land use: This MLRA is largely undisturbed except for a few placer and hard rock mines in the south. There are very few settlements. In Anaktuvuk Pass, the largest settlement, subsistence hunting is the principal occupation.

Elevation and topography: Elevation ranges from 1,800 to 2,400 m in the west to 2,600 m on peaks in the east. The topography is rugged, and several peaks have a permanent ice cover.

Climate: *Average annual precipitation*—250 to 375 mm. The number of days on which some precipitation falls is high. The total annual snowfall is 120 to 200 cm on southern slopes and 60 to 120 cm at the crest and on northern slopes. *Average annual temperature*—About -13 to -9°C. Freezing temperatures may occur in any month.

Water: Several glacially carved lakes are at the north and south boundaries of the Brooks Range. All soils in the area, except a few on steep, forested south-facing slopes, are underlain by permafrost.

Soils: The dominant soils are Orthents and Borolls that have a pergelic temperature regime. Soils are extremely thin or absent in more than 70 percent of the area. Thin Cryorthents and Cryoborolls are on the lower parts of steep slopes. Cryaquepts and Cryaquolls with shallow permafrost occupy most valley bottoms.

Potential natural vegetation: Most of this area is barren. Forests of white spruce, paper birch, and quaking aspen or of black spruce cover some southern slopes and interior valleys. Alpine tundra covers intermediate slopes.

181—Arctic Foothills

127,310 km² (49,160 mi²)

Land use: This MLRA is used primarily for subsistence hunting and fishing. A few reindeer herds are in the southwest. Tundra vegetation covers the entire area except for a relatively small forested site along the lower Noatak River in the southwest. No commercial use is made of the forest, and there is no farming. Some sites in the central part of the area have been explored for oil and gas.

Elevation and topography: Elevation is mainly less than 600 m, but on some hills bordering the Brooks Range it is 1,100 m. The area consists of maturely dissected low hills and ridges. Glaciers have never covered the area.

Climate: *Average annual precipitation*—Generally 125 to 200 mm but 200 to 300 mm in the southwest. The total annual snowfall is generally 60 to 120 cm, but it is about 100 to 200 cm in the southwest. *Average*

annual temperature—About -12°C but about -9 to -7°C in the extreme west. Frosts may occur in any month.

Water: Many streams and rivers are in swales and valleys between the hills, but there are only a few lakes. The entire area, except possibly parts of the lower Noatak River flood plain, is underlain by permafrost. Soils underlain by permafrost are usually wet.

Soils: The dominant soils are Aquepts, which have a pergelic temperature regime. Silty Cryaquepts (Umiat series) underlain by shallow permafrost cover most of the area. Gravelly Cryaquepts with deeper permafrost occupy parts of the flood plains. Cryaquolls underlain by permafrost are common in hills bordering the Brooks Range. Gravelly Cryoborolls and Cryumbrepts are on high ridges and in other areas where surface drainage is good. Gravelly Cryorthents are common on terraces bordering the flood plains of major streams.

Potential natural vegetation: Tundra vegetation, consisting principally of sedges, mosses, and low-growing shrubs, covers most of the area. Forests of white spruce, black spruce, and paper birch are in the lower parts of the Noatak Valley.

182—Arctic Coastal Plain

(62,910 km² (24,290 mi²))

Land use: Most of this MLRA is used only for subsistence hunting and fishing. The sparse popula-

tion is concentrated on the Arctic coast. The area is an important breeding ground for migratory birds. Industrial developments associated with oil production are important near the mouth of the Sagavanirktok River, and such developments probably will take place in other parts of the coastal plain.

Elevation and topography: Elevation is less than 200 m. The area is a gently rolling to level treeless plain with many lakes and rivers.

Climate: *Average annual precipitation*—125 to 200 mm. The total annual snowfall is 50 to 122 cm. *Average annual temperature*—About -12°C . Frosts may occur in any month.

Water: Lakes, ponds, and streams make up more than 20 percent of the area. All soils are underlain by permafrost. Most soils usually are saturated above the permafrost table throughout the summer.

Soils: The dominant soils are Aquepts that have a pergelic temperature regime. Loamy Cryaquepts are dominant, but sandy Cryaquepts are associated with Cryopsamments on dunes south of Barrow, and gravelly Cryaquepts occur in broad flood plains and deltas. Loamy Cryaquolls are extensive in the east. Gravelly Cryochrepts, Cryumbrepts, and Cryoborolls are on sites having exceptionally good surface drainage, but they make up only a very small proportion of the area.

Potential natural vegetation: Tundra vegetation, consisting principally of sedges, mosses, and low-growing shrubs, covers the entire area.

REFERENCES

- Baldwin, M., Charles E. Kellogg, and J. Thorp. 1938. Soil classification. *In* Soils and men, p. 979-1001. U.S. Dep. Agric. Yearb. U.S. Gov. Print. Off., Wash., D.C.
- Cline, M. G., et al. 1955. Soil survey of the Territory of Hawaii. Soil Conserv. Serv., U.S. Dep. Agric. 644 p.
- Fenneman, Nevin M. 1931. Physiography of Western United States. McGraw-Hill, New York and London. 534 p.
- 1938. Physiography of Eastern United States. McGraw-Hill, New York and London. 714 p.
- Flint, Richard F., et al. 1945. Glacial map of North America. Spec. Pap. 60. Part 1, Glacial map (in color); Part 2, bibliog. and explana. notes. Geol. Soc. Amer. 37 p.
- Harper, W. G. 1957. Morphology and genesis of Calcisols. Soil Sci. Soc. Amer. Proc. 21:420-424.
- Kellogg, Charles E. 1941. Climate and soil. *In* Climate and men, p. 276-277. U.S. Dep. Agric. Yearb. U.S. Gov. Print. Off., Wash., D.C.
- 1950. Tropical soils. 4th Int. Congr. Soil Sci. Trans. (Amsterdam) 1:266-276.
- , and I. J. Nygard. 1951. The principal soil groups of Alaska. Agric. Monogr. No. 7, U.S. Dep. Agric. 138 p.
- Küchler, A. W. 1964. Potential natural vegetation of the conterminous United States (map and manual). Amer. Geog. Soc. Spec. Pub. 36. 116 p.
- McClelland, J. E., C. A. Mogen, W. M. Johnson, et al. 1959. Chernozems and associated soils of eastern North Dakota, some properties and topographic relationships. Soil Sci. Soc. Amer. Proc. 23:51-56.
- Marbut, C. F. 1935. Soils of the United States. Part III. *In* Atlas of American agriculture, p. 1-98. U.S. Dep. Agric.
- Marschner, F. J. 1959. Land use and its patterns in the United States. U.S. Dep. Agric. Handb. 153. 277 p.
- Meinzer, Oscar E. 1948. Ground water in the United States, a summary. U.S. Geol. Surv. Water-Supply Pap. 836-D. 232 p.
- National Weather Service, U.S. Dep. Commer. 1959. Climates of the states (climatography of the United States). No. 60-1 through No. 60-51.
- Oakes, H., and J. Thorp. 1951. Dark clay soils of warm regions variously called Redzina, black cotton soils, regur, and tirs. Soil Sci. Soc. Amer. Proc. 15:347-354.
- Simonson, Roy W., F. F. Riecken, and Guy D. Smith. 1952. Great soil groups in Iowa. *In* Understanding Iowa soils, p. 23-25. Wm. C. Brown Co., Dubuque, Iowa.
- Soil Conservation Service, U.S. Dep. Agric. 1968. Published soil surveys. *In* National atlas of the United States of America. Geol. Surv., U.S. Dep. Inter., Wash., D.C.
- 1975. Soil taxonomy: a basic system of soil classification for making and interpreting soil surveys. U.S. Dep. Agric. Handb. 436, 754 p.
- Stose, George W., and O. A. Ljungstedt. 1932. Geologic map of the United States, 1:2,500,000. U.S. Geol. Surv.
- Tavernier, R., and Guy D. Smith. 1957. The concept of Braunerde (Brown Forest soils) in Europe and the United States. Advan. Agron. 9:217-289.
- Thorp, James, and Guy D. Smith. 1949. Higher categories of soil classification. Soil Sci. 67:117-126.
- U.S. Department of Agriculture. 1957. Soil. U.S. Dep. Agric. Yearb. U.S. Gov. Print. Off., Wash., D.C. 784 p.

APPENDIX I. AREA OF LRR'S AND MLRA'S

Table 1 summarizes the approximate area and proportionate extent of the revised land resource regions and major land resource areas in the United States. Major land resource areas 38, 45, 50, 68, 89, and 132, which were discussed in Handbook 296 issued in 1965, are not listed separately because they have been incorporated in other areas.

**Table 1.—Approximate area and proportionate extent of land resource regions
and major land resource areas in the United States**

Land resource region and major land resource area	Area		Extent in—	
			Region	United States
	km ²	mi ²	pct	pct
A—Northwestern Forest, Forage, and Specialty Crop Region	204,080	78,790	—	2.18
1. Northern Pacific Coast Range, Foothills, and Valleys	41,020	15,840	20.1	.44
2. Willamette and Puget Sound Valleys	48,160	18,590	23.6	.52
3. Olympic and Cascade Mountains	65,310	25,210	32.0	.70
4. California Coastal Redwood Belt	13,880	5,360	6.8	.15
5. Siskiyou-Trinity Area	35,710	13,790	17.5	.37
B—Northwestern Wheat and Range Region	239,650	92,530	—	2.56
6. Cascade Mountains, Eastern Slope	37,750	14,570	15.8	.40
7. Columbia Basin	18,520	7,150	7.7	.19
8. Columbia Plateau	42,730	16,500	17.8	.46
9. Palouse and Nez Perce Prairies	23,140	8,940	9.7	.25
10. Upper Snake River Lava Plains and Hills	44,870	17,330	18.7	.49
11. Snake River Plains	35,250	13,610	14.7	.38
12. Lost River Valleys and Mountains	16,380	6,320	6.8	.17
13. Eastern Idaho Plateaus	21,010	8,110	8.8	.22
C—California Subtropical Fruit, Truck, and Specialty Crop Region	167,570	64,700	—	1.79
14. Central California Coastal Valleys	10,380	4,000	6.2	.11
15. Central California Coast Range	21,900	8,460	13.1	.24
16. California Delta	2,310	890	1.3	.02
17. Sacramento and San Joaquin Valleys	49,580	19,140	29.6	.53
18. Sierra Nevada Foothills	7,300	2,820	4.4	.08
19. Southern California Coastal Plain	51,500	19,890	30.7	.55
20. Southern California Mountains	24,600	9,500	14.7	.26
D—Western Range and Irrigated Region	1,461,300	564,210	—	15.61
21. Klamath and Shasta Valleys and Basins	35,350	13,650	2.4	.38
22. Sierra Nevada Range	65,190	25,170	4.5	.70
23. Malheur High Plateau	73,050	28,210	5.0	.78
24. Humboldt Area	37,310	14,400	2.6	.40
25. Owyhee High Plateau	73,050	28,210	5.0	.78
26. Carson Basin and Mountains	23,960	9,250	1.6	.26
27. Fallon-Lovelock Area	32,990	12,740	2.3	.35
28A. Great Salt Lake Area	94,260	36,390	6.5	1.00
28B. Central Nevada Basin and Range	78,150	30,170	5.3	.83
29. Southern Nevada Basin and Range	66,380	25,630	4.6	.71
30. Sonoran Basin and Range	194,030	74,910	13.3	2.07
31. Imperial Valley	9,420	3,640	.6	.10
32. Northern Intermountain Desertic Basins	21,210	8,190	1.5	.23
33. Semiarid Rocky Mountains	11,000	4,250	.8	.12
34. Central Desertic Basins, Mountains, and Plateaus	120,190	46,400	8.2	1.28
35. Colorado and Green River Plateaus	123,350	47,630	8.4	1.32
36. New Mexico and Arizona Plateaus and Mesas	69,130	26,690	4.7	.74
37. San Juan River Valley Mesas and Plateaus	13,350	5,160	.9	.14
39. Arizona and New Mexico Mountains	111,140	42,910	7.6	1.19
40. Central Arizona Basin and Range	47,130	18,200	3.2	.50
41. Southeastern Arizona Basin and Range	45,560	17,590	3.1	.49
42. Southern Desertic Basins, Plains, and Mountains	115,470	44,580	7.9	1.23
48A. Southern Rocky Mountains	630	240	—	.01

**Table 1.—Approximate area and proportionate extent of land resource regions
and major land resource areas in the United States—Continued**

Land resource region and major land resource area	Extent in—			
	Area		Region	United States
	km ²	mi ²		
E—Rocky Mountain Range and Forest Region	597,250	230,600	—	6.38
34. Central Desertic Basins, Mountains, and Plateaus	2,160	830	.3	.02
43. Northern Rocky Mountains	282,650	109,130	47.3	3.02
44. Northern Rocky Mountain Valleys	32,320	12,480	5.4	.35
46. Northern Rocky Mountain Foothills	52,070	20,110	8.7	.56
47. Wasatch and Uinta Mountains	53,150	20,520	8.9	.57
48A. Southern Rocky Mountains	112,050	43,260	18.8	1.20
48B. Southern Rocky Mountain Parks	20,110	7,770	3.4	.21
49. Southern Rocky Mountain Foothills	32,680	12,620	5.5	.35
51. High Intermountain Valleys	10,060	3,880	1.7	.10
F—Northern Great Plains Spring Wheat Region	351,990	135,900	—	3.76
52. Brown Glaciated Plain	52,110	20,120	14.8	.56
53A. Northern Dark Brown Glaciated Plains	30,740	11,870	8.7	.53
53B. Central Dark Brown Glaciated Plains	44,980	17,370	12.8	.48
53C. Southern Dark Brown Glaciated Plains	13,870	5,350	3.9	.15
54. Rolling Soft Shale Plain	58,100	22,430	16.5	.62
55A. Northern Black Glaciated Plains	32,240	12,450	9.2	.34
55B. Central Black Glaciated Plains	52,480	20,260	14.9	.56
55C. Southern Black Glaciated Plains	20,240	7,810	5.8	.22
56. Red River Valley of the North	41,230	15,920	11.7	.44
58A. Northern Rolling High Plains, Northern Part	6,000	2,320	1.7	.06
G—Western Great Plains Range and Irrigated Region	564,490	217,950	—	6.03
58A. Northern Rolling High Plains, Northern Part	99,620	38,460	17.7	1.06
58B. Northern Rolling High Plains, Southern Part	50,810	19,620	9.0	.54
58C. Northern Rolling High Plains, Northeastern Part	8,400	3,240	1.5	.09
58D. Northern Rolling High Plains, Eastern Part	10,000	3,860	1.8	.11
60A. Pierre Shale Plains and Badlands	23,600	9,110	4.2	.25
60B. Pierre Shale Plains, Northern Part	5,600	2,160	1.0	.06
61. Black Hills Foot Slopes	8,400	3,240	1.5	.09
62. Black Hills	9,200	3,550	1.6	.10
63A. Northern Rolling Pierre Shale Plains	29,610	11,430	5.2	.32
63B. Southern Rolling Pierre Shale Plains	28,400	10,970	5.0	.30
64. Mixed Sandy and Silty Tableland	28,400	10,970	5.0	.30
65. Nebraska Sand Hills	56,810	21,930	10.1	.61
66. Dakota-Nebraska Eroded Tableland	12,400	4,800	2.2	.13
67. Central High Plains	74,410	28,730	13.2	.80
69. Upper Arkansas Valley Rolling Plains	34,000	13,130	6.0	.36
70. Pecos-Canadian Plains and Valleys	84,830	32,750	15.0	.91
H—Central Great Plains Winter Wheat and Range Region	575,720	222,280	—	6.15
71. Central Nebraska Loess Hills	26,220	10,120	4.6	.28
72. Central High Tableland	77,220	29,810	13.4	.83
73. Rolling Plains and Breaks	59,260	22,880	10.3	.63
74. Central Kansas Sandstone Hills	12,210	4,710	2.1	.13
75. Central Loess Plains	34,840	13,450	6.1	.37
76. Bluestem Hills	19,400	7,490	3.3	.21
77. Southern High Plains	126,780	48,950	22.0	1.36
78. Central Rolling Red Plains	130,370	50,340	22.7	1.39
79. Great Bend Sand Plains	10,770	4,160	1.9	.12
80A. Central Rolling Red Prairies	48,840	18,860	8.5	.52
80B. Texas North-Central Prairies	25,500	9,850	4.5	.27
81. Edwards Plateau	720	280	—	—
84A. Cross Timbers	3,590	1,380	.6	.04

**Table 1.—Approximate area and proportionate extent of land resource regions
and major land resource areas in the United States—Continued**

Land resource region and major land resource area	Extent in—			
	Area		Region	United States
	km ²	mi ²		
I—Southwest Plateaus and Plains Range and Cotton Region	175,990	67,950	—	1.88
81. Edwards Plateau	96,050	37,090	54.6	1.03
82. Texas Central Basin	5,500	2,120	3.1	.06
83A. Northern Rio Grande Plain	20,900	8,070	11.9	.22
83B. Western Rio Grande Plain	23,470	9,060	13.3	.25
83C. Central Rio Grande Plain	23,470	9,060	13.3	.25
83D. Lower Rio Grande Valley	6,600	2,550	3.8	.07
J—Southwestern Prairies Cotton and Forage Region	145,120	56,030	—	1.55
80A. Central Rolling Red Prairies	3,860	1,490	2.7	.04
84A. Cross Timbers	27,400	10,580	18.9	.29
84B. West Cross Timbers	15,050	5,810	10.4	.16
84C. East Cross Timbers	5,790	2,240	3.8	.06
85. Grand Prairie	31,650	12,220	21.9	.34
86. Texas Blackland Prairie	47,860	18,480	33.0	.51
87. Texas Claypan Area	13,510	5,210	9.3	.15
K—Northern Lake States Forest and Forage Region	277,100	106,990	—	2.96
57. Northern Minnesota Gray Drift	21,440	8,280	7.7	.23
88. Northern Minnesota Glacial Lake Basins	31,010	11,970	11.2	.33
90. Central Wisconsin and Minnesota Thin Loess and Till	55,750	21,530	20.1	.60
91. Wisconsin and Minnesota Sandy Outwash	52,780	20,380	19.1	.56
92. Superior Lake Plain	4,950	1,910	1.8	.05
93. Superior Stony and Rocky Loamy Plains and Hills	56,080	21,650	20.2	.60
94A. Northern Michigan and Wisconsin Sandy Drift	39,920	15,410	14.4	.43
94B. Michigan Eastern Upper Peninsula Sandy Drift	15,170	5,860	5.5	.16
L—Lake States Fruit, Truck, and Dairy Region	193,780	74,820	—	2.07
95A. Northeastern Wisconsin Drift Plain	15,760	6,090	8.1	.17
95B. Southern Wisconsin and Northern Illinois Drift Plain	28,530	11,020	14.7	.31
96. Western Michigan and Northeastern Wisconsin Fruit Belt	10,650	4,110	5.5	.11
97. Southwestern Michigan Fruit and Truck Belt	5,960	2,300	3.1	.06
98. Southern Michigan and Northern Indiana Drift Plain	60,050	23,190	31.0	.64
99. Erie-Huron Lake Plain	35,780	13,810	18.5	.38
100. Erie Fruit and Truck Area	4,260	1,640	2.2	.05
101. Ontario Plain and Finger Lakes Region	32,790	12,660	16.9	.35
M—Central Feed Grains and Livestock Region	725,500	280,110	—	7.75
102A. Rolling Till Prairie	38,600	14,900	5.3	.41
102B. Loess Uplands and Till Plains	43,790	16,910	6.0	.48
103. Central Iowa and Minnesota Till Prairies	71,990	27,800	9.9	.77
104. Eastern Iowa and Minnesota Till Prairies	22,640	8,740	3.1	.24
105. Northern Mississippi Valley Loess Hills	57,520	22,210	8.0	.61
106. Nebraska and Kansas Loess-Drift Hills	27,090	10,460	3.7	.29
107. Iowa and Missouri Deep Loess Hills	53,810	20,770	7.4	.57
108. Illinois and Iowa Deep Loess and Drift	79,790	30,800	11.0	.85
109. Iowa and Missouri Heavy Till Plain	37,110	14,330	5.1	.40
110. Northern Illinois and Indiana Heavy Till Plain	26,350	10,170	3.6	.28
111. Indiana and Ohio Till Plain	84,980	32,810	11.7	.91
112. Cherokee Prairies	57,520	22,210	8.0	.61
113. Central Claypan Areas	28,570	11,030	4.0	.31
114. Southern Illinois and Indiana Thin Loess and Till Plain	34,880	13,470	4.8	.37
115. Central Mississippi Valley Wooded Slopes	60,860	23,500	8.4	.65

**Table 1.—Approximate area and proportionate extent of land resource regions
and major land resource areas in the United States—Continued**

Land resource region and major land resource area	Extent in—			
	Area		Region	United States
	km ²	mi ²		
N—East and Central Farming and Forest Region	612,230	236,380	—	6.54
116A. Ozark Highland	69,810	26,950	11.4	.75
116B. Ozark Border	35,470	13,690	5.8	.38
117. Boston Mountains	14,930	5,770	2.4	.16
118. Arkansas Valley and Ridges	27,250	10,520	4.5	.29
119. Ouachita Mountains	24,640	9,510	4.0	.26
120. Kentucky and Indiana Sandstone and Shale Hills and Valleys	30,990	11,970	5.1	.33
121. Kentucky Bluegrass	29,490	11,390	4.8	.32
122. Highland Rim and Pennyroyal	52,640	20,320	8.6	.56
123. Nashville Basin	15,680	6,060	2.6	.17
124. Western Allegheny Plateau	19,040	7,350	3.1	.20
125. Cumberland Plateau and Mountains	63,840	24,640	10.4	.68
126. Central Allegheny Plateau	50,770	19,600	8.3	.54
127. Eastern Allegheny Plateau and Mountains	43,680	16,870	7.1	.47
128. Southern Appalachian Ridges and Valleys	69,430	26,810	11.3	.74
129. Sand Mountain	17,540	6,770	2.9	.19
130. Blue Ridge	47,030	18,160	7.7	.50
O—Mississippi Delta Cotton and Feed Grains Region	116,080	44,820	—	1.24
131. Southern Mississippi Valley Alluvium	93,600	36,140	80.6	1.00
134. Southern Mississippi Valley Silty Uplands	22,480	8,680	19.4	.24
P—South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region	688,050	265,660	—	7.35
112. Cherokee Prairies	1,890	730	.3	.02
133A. Southern Coastal Plain	285,050	110,060	41.4	3.05
133B. Western Coastal Plain	140,640	54,300	20.4	1.50
134. Southern Mississippi Valley Silty Uplands	51,410	19,850	7.5	.55
135. Alabama, Mississippi, and Arkansas Blackland Prairie	21,550	8,320	3.1	.23
136. Southern Piedmont	161,430	62,330	23.5	1.72
137. Carolina and Georgia Sand Hills	22,680	8,760	3.3	.24
138. North-Central Florida Ridge	3,400	1,310	.5	.04
R—Northeastern Forage and Forest Region	314,540	121,440	—	3.36
139. Eastern Ohio Till Plain	15,030	5,800	4.8	.16
140. Glaciated Allegheny Plateau and Catskill Mountains	70,540	27,240	22.4	.75
141. Tughill Plateau	3,080	1,190	1.0	.03
142. St. Lawrence-Champlain Plain	14,260	5,510	4.5	.15
143. Northeastern Mountains	101,760	39,290	32.4	1.09
144A. New England and Eastern New York Upland, Southern Part	52,040	20,090	16.5	.56
144B. New England and Eastern New York Upland, Northern Part	48,570	18,750	15.4	.52
145. Connecticut Valley	6,560	2,530	2.1	.07
146. Aroostook Area	2,700	1,040	.9	.03
S—Northern Atlantic Slope Diversified Farming Region	105,780	40,840	—	1.13
147. Northern Appalachian Ridges and Valleys	48,210	18,610	45.6	.52
148. Northern Piedmont	29,870	11,530	28.2	.32
149A. Northern Coastal Plain	20,870	8,060	19.7	.22
149B. Long Island-Cape Cod Coastal Lowland	6,830	2,640	6.5	.07
T—Atlantic and Gulf Coast Lowland Forest and Crop Region	247,140	95,420	—	2.64
150A. Gulf Coast Prairies	41,710	16,100	16.9	.45
150B. Gulf Coast Saline Prairies	13,100	5,060	5.3	.14
151. Gulf Coast Marsh	21,030	8,120	8.5	.22
152A. Eastern Gulf Coast Flatwoods	34,120	13,170	13.8	.36
152B. Western Gulf Coast Flatwoods	16,890	6,520	6.8	.18
153A. Atlantic Coast Flatwoods	73,760	28,480	29.9	.79
153B. Tidewater Area	31,020	11,980	12.6	.33
153C. Mid-Atlantic Coastal Plain	15,510	5,990	6.2	.17

**Table 1.—Approximate area and proportionate extent of land resource regions
and major land resource areas in the United States—Continued**

Land resource region and major land resource area	Extent in—			
	Area		Region	United States
	km ²	mi ²		
U—Florida Subtropical Fruit, Truck Crop, and Range Region	94,550	36,510	—	1.01
154. South-Central Florida Ridge	24,290	9,380	25.6	.26
155. Southern Florida Flatwoods	54,570	21,070	57.8	.58
156A. Florida Everglades and Associated Areas	11,210	4,330	11.9	.12
156B. Southern Florida Lowlands	4,480	1,730	4.7	.05
V—Hawaii Region	16,850	6,510	—	.18
157. Arid and Semiarid Low Mountain Slopes	1,290	500	7.7	.01
158. Semiarid and Subhumid Low Mountain Slopes	1,270	490	7.5	.01
159. Humid and Very Humid Low and Intermediate Mountain Slopes	2,320	900	13.7	.02
160. Subhumid and Humid Intermediate and High Mountain Slopes	910	350	5.4	.01
161. Lava Flows and Rock Outcrops	7,060	2,730	41.9	.08
162. Very Humid Areas on East and West Maui Mountains, Kohala Mountains, and Mount Waialeale	590	230	3.5	.01
163. Alluvial Fans and Coastal Plains	320	120	1.9	—
164. Rough Mountainous Lands	1,100	430	6.6	.01
165. Subhumid Intermediate Mountain Slopes	300	110	1.8	—
166. Very Stony Land and Rock Land	1,250	480	7.4	.01
167. Humid Low and Intermediate Mountain Slopes	440	170	2.6	—
W—Southern Alaska Region	321,090	123,970	—	3.43
168. Southeastern Alaska	86,490	33,390	26.9	.93
169. South-Central Alaska Mountains	98,080	37,870	30.6	1.05
170. Cook Inlet-Susitna Lowland	43,080	16,630	13.4	.46
171. Alaska Peninsula and Southwestern Islands	93,440	36,080	29.1	.99
X—Interior Alaska Region	659,970	254,820	—	7.05
172. Cooper River Plateau	37,910	14,640	5.7	.41
173. Alaska Range	70,500	27,220	10.7	.75
174. Interior Alaska Lowlands	161,490	62,350	24.5	1.73
175. Kuskokwim Highlands	175,510	67,770	26.6	1.87
176. Interior Alaska Highlands	214,560	82,840	32.5	2.29
Y—Arctic and Western Alaska Region	505,510	195,180	—	5.40
177. Norton Sound Highlands	114,960	44,390	22.8	1.23
178. Western Alaska Coastal Plains and Deltas	80,510	31,080	15.9	.86
179. Bering Sea Islands	12,350	4,770	2.4	.13
180. Brooks Range	107,470	41,490	21.3	1.15
181. Arctic Foothills	127,310	49,160	25.2	1.36
182. Arctic Coastal Plain	62,910	24,290	12.4	.67
Total	9,361,330	3,614,410		

APPENDIX II. SOIL CLASSIFICATION

Appendix II provides abridged definitions and brief general descriptions of the orders, suborders, and great groups in the system of soil classification used in the National Cooperative Soil Survey. Information is included for 10 orders, 47 suborders, and 230 great groups. The orders, the suborders within each order, and the great groups within each suborder are arranged alphabetically.

Table 2 presents the great soil groups according to the 1938 classification, as revised in 1959, and gives their approximate equivalents in the present system of classification.

Detailed descriptions and definitions of individual classes in the four upper categories are in USDA Agriculture Handbook 436, Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys.

Alfisols

Alfisols are extensive in humid, temperate regions. They occur largely in plains having low or moderate relief. The distinguishing characteristics of Alfisols are: (1) An A horizon that has lost silicate clay, sesquioxides, and bases, (2) a B horizon that has accumulations of silicate clay (argillic or natric horizons), and (3) a moderate to high content of exchangeable calcium and magnesium. With few exceptions, an uneroded Alfisol has a dark surface horizon a few centimeters thick (an inch or two) over an ochric epipedon or an albic horizon (a pale horizon as much as 30 cm, 12 in., thick) grading below into an argillic horizon. The order of Alfisols consists of the suborders Aqualfs, Boralfs, Udalfs, Ustalfs, and Xeralfs.

Aqualfs

Aqualfs are the periodically wet Alfisols that occur either in depressions or on wide flats. These soils are wet much of the year but dry out to some depth from time to time. The great groups of this suborder and the features characteristic of each are:

Albaqualfs—An albic horizon (nearly white A2 horizon) or an argillic horizon with an abrupt upper boundary.

Duraqualfs—A duripan (silica-cemented layer) below an argillic horizon.

Fragiaqualfs—A fragipan (subsurface horizon that is compact and brittle but not indurated).

Glossaqualfs—An albic horizon above an argillic horizon with tongues of pale or even white material extending into the argillic horizon.

Natraqualfs—A natric horizon (a form of argillic horizon having appreciable sodium and a distinct blocky structure).

Ochraqualfs—Type specimens for the suborder. These soils have the minimum required horizons and other features of the suborder. They have an ochric epipedon above an argillic horizon.

Plinthaqualfs—Plinthite forming half or more of some subhorizon of the argillic horizon within 1.25 m (50 in.) of the soil surface.

Tropaqualfs—An ochric epipedon or an albic horizon above an argillic horizon. Tropaqualfs occur in tropical and subtropical regions. The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Umbrqualfs—An umbric epipedon rather than an ochric epipedon like the Ochraqualfs, but the characteristics of the two otherwise are similar.

Boralfs

Boralfs are the cold and relatively well drained Alfisols of high latitudes and high mountains. The mean annual soil temperature is less than 8°C (47°F). The moisture level is moderate to high most of the time, but the soils may be dry for 90 days throughout the year. The great groups of this suborder and the features characteristic of each are:

Cryoboralfs—The coldest of all the soils in the suborder. The mean annual soil temperature ranges from 0 to 8°C (32 to 47°F). The mean soil temperature during the warmest three months of the year is less than 15°C (59°F).

Eutroboralfs—A high content of bases such as calcium and magnesium but not of sodium. Many have accumulations of calcium carbonate immediately below or in the lower part of the argillic horizon.

Fragiboralfs—A fragipan (subsurface horizon that is compact and brittle but not indurated).

Glossoboralfs—An albic horizon above an argillic horizon, usually with tongues of the albic material extending into the argillic horizon.

Natroboralfs—A natric horizon (a form of argillic horizon having appreciable sodium and a distinct blocky structure).

Paleboralfs—A thick albic horizon over an argillic horizon. The upper boundary of the argillic horizon is more than 60 cm (24 in.) below the soil surface.

Udalfs

Udalfs are relatively well drained Alfisols of temperate, subtropical, and tropical humid climates. The mean annual soil temperature is more than 8°C (47°F). The moisture level is moderate to high; some part of the

profile may be dry for 90 days or less in any one year. The great groups of this suborder and the features characteristic of each are:

Agrudalfs—Cultivated for centuries; consequently, these soils have an accumulation of humus, clay, and silt (an agric horizon) immediately below the plow layer.

Ferrudalfs—A discontinuous argillic horizon, fragments of which are coated and weakly cemented with iron oxides.

Fragiudalfs—A fragipan (subsurface horizon that is compact and brittle but not indurated).

Fraglossudalfs—Tongues of albic material (virtually white soil material low in content of clay) extending through the argillic horizon, below which is a fragipan.

Glossudalfs—Tongues of albic material extending down and commonly through the argillic horizon. These soils have no fragipan.

Hapludalfs—Type specimens for the suborder. These soils have an ochric epipedon over a brown or yellowish brown argillic horizon.

Natrudalfs—A natric horizon (a form of argillic horizon having appreciable sodium and a distinct blocky structure).

Paleudalfs—A thick, reddish argillic horizon. These soils are believed to be the oldest of all the soils in the suborder. The argillic horizon extends to a depth of 1.5 m (60 in.) or more.

Rhodudalfs—A dark red argillic horizon that is not so thick as that of Paleudalfs.

Tropudalfs—Similar to Hapludalfs in morphology and composition, but these soils occur in tropical regions. The argillic horizon commonly is red or reddish brown. The mean annual soil temperature generally is more than 15°C (59°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Ustalfs

Ustalfs are the well-drained Alfisols of warm-temperate, subtropical, and tropical regions where most of the rain falls during the warm season. The mean annual soil temperature is more than 8°C (47°F). Some part of the profile is dry for as much as half of the year, but the profile is moist for 90 consecutive days during the growing season. The great groups of this suborder and the features characteristic of each are:

Durustalfs—A duripan (silica-cemented horizon) beneath an argillic horizon.

Haplustalfs—Type specimens for the suborder. The profile has no horizon in addition to the required sequence nor any special features.

Natrustalfs—A natric horizon (a form of argillic horizon having appreciable sodium and either a blocky or prismatic structure, or both).

Paleustalfs—A thick, reddish argillic horizon. These soils are believed to be relatively old. They have an argillic horizon that has a high proportion of clay to a depth of 1.5 m (60 in.) or more.

Plinthustalfs—Plinthite forms one-half or more of some subhorizon of the argillic horizon within 1.25 m (50 in.) of the soil surface.

Rhodustalfs—A dark red argillic horizon that is thinner than that of Paleustalfs.

Xeralfs

Xeralfs are the well-drained Alfisols of temperate regions in which most of the rain falls during the cool season. The mean annual soil temperature ranges from 8 to 22°C (47 to 72°F). The profile is dry throughout for at least 45 consecutive days during the growing season. Except for the great group Rhodoxeralfs in this suborder, these soils have an A horizon that is very hard when dry. The great groups of this suborder and the features characteristic of each are:

Durixeralfs—A duripan (silica-cemented layer) beneath an argillic horizon.

Haploxeralfs—Type specimens for the suborder. The profile has only the number and kinds of horizons required for the suborder.

Natrixeralfs—A natric horizon (a form of argillic horizon) having appreciable sodium and either a blocky or prismatic structure, or both.

Palexeralfs—A thick, reddish but not dark red, argillic horizon having a high content of clay. The proportion of clay decreases slightly but slowly with increasing depth.

Plinthoxeralfs—Plinthite forms more than half of some subhorizon of the argillic horizon within 1.25 m (50 in.) of the soil surface.

Rhodoxeralfs—Fairly uniform dark red throughout the profile.

Aridisols

Aridisols are major components of soil patterns in dry regions (the deserts), which make up about one-fourth of the land surface of the earth. Landforms range from fairly level plains to distinct mountains. Characteristics common to Aridisols are: (1) Extended periods in which little or no moisture is available to plants, (2) one or more evident horizons, (3) a thin and rather pale surface horizon that has slight accumulations of humus (ochric epipedon), and (4) a soil surface without wide cracks at any time. All Aridisols have a low content of organic matter and relatively pale colors. Most have an accumulation of calcium carbonate at some depth in the profile. The order of Aridisols consists of the suborders Argids and Orthids.

Argids

Among the Aridisols, Argids occupy the oldest land surfaces. All members of the suborder have a B horizon marked by an accumulation of silicate clays. Some have a B horizon that has appreciable sodium (natric horizon) but others do not (argillic horizon). The great groups of this suborder and the features characteristic of each are:

Duragids—A duripan (silica-cemented layer) below an argillic horizon.

Haplargids—The simplest profile of all the soils in the suborder; they have an ochric epipedon (light-colored A horizon) over an argillic horizon but no extra features beyond the required minimum.

Nadurargids—A natric horizon overlying a duripan. The natric horizon is sticky and plastic when wet and hard when dry. Structure commonly is prismatic or blocky, or both.

Natrargids—A natric horizon in which the structure is prismatic or blocky, or both.

Paleargids—A thick argillic horizon having a high content of clay or a petrocalcic horizon (carbonate-cemented subsurface layer), or both.

Orthids

Orthids have a pale surface horizon (ochric epipedon) and one or more of some type of distinct subsurface

horizons, other than the B horizon, marked by an accumulation of silicate clay. Such subsurface horizons extend to a depth of 25 cm (10 in.) or more. The great groups of this suborder and the feature characteristic of each are:

Calciorthids—A calcic horizon (subsurface layer greatly enriched in carbonates) and a profile that generally has a moderate to high calcium carbonate content.

Camborthids—A cambic horizon that is brownish or reddish and brighter than the overlying and underlying horizons. Camborthids have an ochric epipedon (light-colored A horizon) and usually have an accumulation of carbonates below the cambic horizon.

Durorthids—A duripan within 1 m (40 in.) of the soil surface usually, but not always, below a cambic horizon.

Gypsiorthids—A gypsic horizon (subsurface layer enriched in gypsum) within 1 m (40 in.) of the soil surface. Gypsiorthids are pale in color throughout the profile.

Paleorthids—A petrocalcic horizon (carbonate-cemented subsurface layer) within 1 m (40 in.) of the soil surface.

Salorthids—A salic horizon (layer enriched in salts more soluble than gypsum) within the uppermost 75 cm (30 in.). The soils generally occur in depressions.

Entisols

Entisols are on land surfaces that range from level alluvial plains to steep mountain slopes, most of which are young. The lack of horizons except for a thin one at the surface is the identifying characteristic of Entisols. Many have an ochric epipedon (pale but not white surface layer), and some have an albic horizon (a white layer near the surface). These layers are so thin that they would be destroyed if the soils were plowed. The order of Entisols consists of the suborders Aquents, Arents, Fluvents, Orthents, and Psamments.

Aquents

Aquents are the wet Entisols that occur in low places such as marshes and parts of flood plains and deltas. The great groups of this suborder and the features characteristic of each are:

Cryaquents—Coldest of all the soils in the suborder. The mean annual soil temperature ranges from 0 to 8°C (32 to 47°F). The mean soil temperature during the three warmest months of the year is less than 15°C (59°F).

Fluvaquents—Wet soils on flood plains and in deltas in regions of middle and low latitudes. The vertical distribution of organic matter in the profile is irregular.

Haplaquents—Occur in upland depressions where small amounts of sediments infrequently accumulate. These soils lack stratification. Their content of organic matter gradually decreases with increasing depth, and they are firm underfoot. Texture is sandy loam or finer throughout most of the profile. The mean annual soil temperature is above 8°C (47°F).

Hydraquents—Always saturated with water. These soils have a high content of clay and a low bearing capacity. They are too soft to support grazing animals.

Psammaquents—The sandy soils of the suborder.

Sulfaquents—Contains moderate to large amounts of sulfides and few or no carbonates in the uppermost 50 cm (20 in.). These soils are saturated with water all or most of the time.

Tropaquents—Occur in upland depressions in the tropics and subtropics. The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C (9°F).

Arents

Arents are Entisols in which the original horizons have been destroyed by mechanical disturbances. Fragments of former horizons, such as argillic horizons and fragipans, occur in some Arents. These soils have been identified chiefly in western Europe but probably occur

widely in eastern Asia and will become more common elsewhere as progressively larger equipment becomes available for earthmoving and landshaping. No great groups have been defined for this suborder.

Fluvents

Fluvents are well drained and moderately well drained Entisols that formed in recent alluvium, much of which accumulated during the last few centuries. They are on flood plains that are subject to active deposition but not to ponding. Texture in the upper 1 m (40 in.) of the profile is sandy loam or finer. Organic carbon is irregularly distributed in the profile. The great groups of this suborder and the features characteristic of each are:

Cryofluvents—The coldest of all the soils in this suborder. The mean annual soil temperature ranges from 0 to 8°C (32 to 47°F). The mean soil temperature during the warmest months is below 15°C (59°F). When these soils thaw, they are not dry for long periods.

Torrifluvents—Dry throughout the profile or in most parts more than half of the year. The profile is never moist throughout for 90 consecutive days.

Tropofluvents—The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F. The profile is not dry throughout for as many as 90 days during the year.

Udifluvents—Dry throughout the profile less than 90 days per year.

Ustifluvents—Moist in some part of the profile for half of the year or continuously moist for 90 days during the growing season.

Xerofluvents—Profile is dry throughout for 45 or more consecutive days during the growing season. Most Xerofluvents have a mean annual soil temperature higher than 0°C (32°F).

Orthents

Orthents occur chiefly on recently eroded slopes, but some are in recent loamy or finer loess, mudflows, and gravelly or cobbly alluvium. Some Orthents have a faint or thin A horizon, but most have a C horizon at the surface. The great groups of this suborder and the features characteristic of each are:

Cryorthents—The coldest of all the soils in the suborder. The mean annual soil temperature is below 8°C (47°F). The mean soil temperature during the three warmest months of the year is below 15°C (59°F).

Torriorthents—The driest of all the soils in the suborder. The profile is dry throughout most of the year and is never moist throughout for 90 consecutive days during the year.

Troporthents—Occur in tropical and subtropical re-

gions where rainfall is plentiful. The profile is not dry throughout for as many as 90 days a year. The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Udorthents—Occur in regions where moisture is adequate. These soils are not dry throughout the profile for a total of 90 days per year.

Ustorthents—Occur in subhumid and semiarid regions. The profile is moist in some part for half of the year or is continuously moist for 90 days during the warm season.

Xerorthents—Occur in regions where most of the rain falls in winter. These soils are dry for 45 or more consecutive days during the warm season.

Psamments

Psamments are the sandy Entisols. The soil is sand to a depth of at least 1 m (40 in.) and is neither gravelly nor cobbly. Quartz is the most common mineral in these soils. The great groups of this suborder and the features characteristic of each are:

Cryopsamments—The coldest of all the soils in the suborder. The mean annual soil temperature is below 8°C (47°F). The mean soil temperature during the three warmest months of the year is below 15°C (59°F).

Quartzipsamments—Contain a high percentage of quartz, the grains of which are largely free of any coatings.

Torriipsamments—The driest of all the soils in the suborder. These soils are dry for half of the year and are never moist for 90 consecutive days a year. They are dry most of the time because of their limited capacity to hold water.

Tropopsamments—The warmest of all the soils in the suborder. The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Udipsamments—Occur in regions that have adequate rainfall. The mean annual soil temperature is above 8°C (47°F), but the difference between the mean soil temperature of the warm season and that of the cool season is 5°C or 9°F or more.

Ustipsamments—Occur in subhumid and semiarid regions that have adequate rainfall. Rainfall comes during the warm season but is generally ineffective because of the limited capacity of the sands to hold moisture.

Xeropsamments—Occur in regions where most of the rain falls during usually mild winters. The precipitation is ineffective because the moisture storage capacity of the sands is low.

Histosols

Histosols are dominantly organic. Most Histosols have restricted drainage and are saturated with water most of the year. The distinguishing characteristics are: (1) A high percentage of organic matter, (2) wetness, and (3) some mineral matter in the profile. The content or proportion of organic matter may be a little more than one-fifth by weight, as a minimum, but is always more than one-half by volume. The profile may have sequences of layers, but they reflect stages in accumulation of materials rather than the formation of soil horizons. The order of Histosols consists of the suborders Fibrists, Folists, Hemists, and Saprist.

Fibrists

Fibrists consist mainly of slightly decomposed organic matter. Plant structures are evident, and the plant species can be determined. Fibrists generally are light in weight and low in ash. The great groups of this suborder and the features characteristic of each are:

Borofibrists—The mean annual soil temperature is below 8°C (47°F). The profile does not remain frozen in some part nor does it remain very cold during the summer.

Cryofibrists—The coldest of all the soils in the suborder. The mean annual soil temperature is below 8°C (47°F). The profile is likely to be frozen at some depth or to remain cold throughout the summer.

Luvifibrists—A subsurface layer at least 2 cm (0.8 in.) thick in which downward moving humus has accumulated.

Medifibrists—The mean annual soil temperature is above 8°C (47°F). The difference between the soil temperature of the warm season and that of the cold season is 5°C or 9°F or more.

Sphagnofibrists—Consist largely of the remains of sphagnum mosses. The mean annual soil temperature is generally below 8°C (47°F).

Tropofibrists—Occur in tropical and subtropical regions, chiefly in coastal swamps. The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature of warm seasons and that of cool seasons is less than 5°C or 9°F.

Folists

Folists consist of forest litter resting on gravel, rubble, or rock, commonly on strong or steep slopes. Drainage is free, but some combination of one or more of frequent rain, fog, and low temperatures keeps the litter wet much of the time. The great groups of the suborder and the features characteristic of each are:

Borofolists—The mean annual soil temperature is below 8°C (47°F). The mean soil temperature during the three warmest months is above 15°C (59°F).

Cryofolists—The mean annual soil temperature is below 8°C (47°F). The mean soil temperature during the three warmest months is below 15°C (59°F).

Tropofolists—The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Hemists

Hemists consist of moderately decomposed organic

residues. Few plant structures are evident, but vigorous rubbing of soil materials between the fingers does not destroy all fibers. The great groups of this suborder and the features characteristic of each are:

Borohemists—The mean annual soil temperature is below 8°C (47°F). The profile does not remain frozen in some parts nor does it remain very cold during the summer.

Cryohemists—The mean annual soil temperature is below 8°C (47°F). The profile remains frozen in some parts or is very cold throughout the summer.

Luvihemists—A subsurface layer at least 2 cm (0.8 in.) thick in which downward moving humus has accumulated.

Medihemists—The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature during warm and cool seasons is 5°C or 9°F or more.

Sulfihemists—Appreciable amounts of sulfides in some part of the profile within a depth of 1 m (40 in.).

Sulfohemists—Appreciable amounts of sulfuric acid in some part of the profile.

Tropohemists—The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Saprist

Saprist consist of strongly decayed organic matter. Very few plant structures can be identified. Vigorous rubbing of soil materials between the fingers destroys virtually all fibers. Saprist are dry for part of the year. The great groups of this suborder and the features characteristic of each are:

Borosaprist—The mean annual soil temperature is below 8°C (47°F). The profile does not remain frozen in some parts, nor does it remain very cold in all parts throughout the summer.

Cryosaprist—The mean annual soil temperature is below 8°C (47°F). The profile remains frozen at some depth or is very cold throughout in summer.

Medisaprist—The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is 5°C or 9°F or more.

Troposaprist—The mean annual temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Inceptisols

Inceptisols are most extensive in humid regions. They also occur in subhumid and semiarid zones but not in deserts. These soils are moist for appreciable periods, and available water is present either for more than half of each year or for more than 90 consecutive days each year. Identifying characteristics are: (1) Few or faint horizons, (2) a good to fair moisture regime, (3) some weatherable minerals, (4) a texture finer than loamy fine sand, and (5) clay fractions with moderate to high activity. Many Inceptisols have a subsurface horizon of alteration and loss known as a cambic horizon. The order of Inceptisols consists of the suborders Andepts, Aquepts, Ochrepts, Plaggepts, Tropepts, and Umbrepts.

Andepts

Andepts formed in regoliths consisting of volcanic ash or pumice or having large components of pyroclastic materials. Most Andepts have a dark A horizon, below which the moist soil materials smear badly when rubbed vigorously between the fingers. The soils have a low bulk density and therefore are light and fluffy. Most are acid, and some are strongly acid. Although not all these soils are well drained, none of them is wet. The great groups of this suborder and the features characteristic of each are:

Cryandepts—The coldest of all the soils in the suborder. They occur in high latitudes and in high mountains. The mean annual soil temperature is below 8°C (47°F). The mean soil temperature during the three warmest months is below 15°C (59°F). The coldest soils have permafrost.

Durandepts—A duripan (silica-cemented horizon) below a cambic horizon within 1 m (40 in.) of the soil surface.

Dystrandepts—Moderately to strongly acid. These soils have a low level of bases such as calcium and a high content of organic matter.

Eutrandepts—Slightly acid to neutral. They have a high content of bases such as calcium and a high content of organic matter.

Hydrandepts—Dark soils through which water moves downward almost continuously because of the uniform rainfall in regions where they occur. These soils never dry out under natural conditions, but if artificially dried, the soil material hardens into small lumps.

Placandepts—A placic horizon (thin and hard subsurface layer cemented by oxides of iron or oxides of iron and manganese or by iron-organic complexes).

Vitrandepts—A high proportion of slightly weathered volcanic glass or pumice. These soils feel like sandy loam or loamy sand rather than silt loam.

Aquepts

Aquepts are the wet Inceptisols that occur mostly on flats and in low places. Water is present in the soils most of the time. Many Aquepts have a dark A horizon a few centimeters thick, but in some this horizon is as much as 30 cm (12 in.) thick. The great groups of this suborder and the feature characteristic of each are:

Andaquepts—Formed in parent materials containing large amounts of volcanic glass or other pyroclastic

sediments. Most Andaquepts have a thick, dark A horizon.

Cryaquepts—Coldest of all the soils in the suborder. The mean annual soil temperature is below 8°C (47°F). The mean soil temperature during the warm season is below 15°C (59°F). The coldest Cryaquepts have permafrost.

Fragiaquepts—A fragipan (subsurface horizon that is compact and brittle but not indurated).

Halaquepts—Contain appreciable quantities of exchangeable sodium and could be considered sodic soils. Some of these soils are saline.

Haplaquepts—Type-specimens for the suborder. These soils have the gray cambic horizon required for the suborder but no extra horizons or other features.

Humaquepts—A thick, dark A horizon or thin coverings of peat or peaty materials above a gray cambic horizon.

Placaquepts—A placic horizon (layer a few centimeters thick cemented by one or more of the oxides of iron and manganese or by iron-organic complexes). This layer is within 1 m (40 in.) of the soil surface.

Plinthaquepts—Plinthite forms half or more of some subhorizon within 1.25 m (50 in.) of the soil surface but at a depth of more than 30 cm (12 in.). Plinthite consists of local concentrations of iron oxide that appears as dark red mottles on an exposed face and that hardens upon repeated wetting and drying.

Sulfaquepts—Moderate or larger amounts of sulfides in the profile have been converted to sulfuric acid through drainage and oxidation.

Tropaquepts—Occur in tropical and subtropical regions. The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Ochrepts

Ochrepts are the freely drained Inceptisols characteristically having an ochric epipedon (pale but not white A horizon) over a brownish cambic horizon. The great groups of this suborder and the features characteristic of each are:

Cryochrepts—Coldest of all the soils in the suborder. The mean annual soil temperature is below 8°C (47°F). The mean soil temperature during the warm season is below 15°C (59°F).

Durochrepts—A duripan (silica-cemented horizon) below a cambic horizon but within 1 m (40 in.) of the soil surface.

Dystrochrepts—Moderately to strongly acid. These soils have a low level of bases such as calcium.

Eutrochrepts—Slightly acid to neutral. These soils have a high level of bases such as calcium and a moderately high organic matter content. The profile is moist throughout at least 90 days a year.

Fragiochrepts—A fragipan (subsurface horizon that is compact and brittle but not indurated).

Ustochrepts—Occur in subhumid to semiarid regions where most of the rain falls during the warm season. The profile of these soils is moist in some part for 180 days a year or is continuously moist for 90 days during the growing season.

Xerochrepts—Occur in regions where most of the rain falls during the cool season. All parts of the profile are dry for 45 or more consecutive days during the growing season.

Plaggepts

Plaggepts are the Inceptisols that have a very thick dark surface horizon formed by additions of mixed organic and mineral materials such as manure or human wastes. The dark surface layer is called a plaggen epipedon. No great groups have been defined for this suborder.

Tropepts

These soils are the well drained and moderately well drained Inceptisols of tropical and subtropical regions. Most have an ochric epipedon or a light-colored A horizon, but some have a dark A horizon. All have a brownish or reddish cambic horizon. The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F. The great groups of this suborder and the features characteristic of each are:

Dystropepts—Moderately to strongly acid. These soils have a low level of bases such as calcium.

Eutropepts—Slightly acid to neutral. These soils have a high level of bases such as calcium.

Humitropepts—A high or relatively high percentage of organic matter and a low level of bases such as calcium. Some of these soils have an ochric epipedon, but many have an umbric epipedon (dark and strongly acid A horizon). All have a brownish or reddish cambic horizon.

Sombritropepts—High organic matter content. These soils have a sombric horizon (dark or very dark subsurface horizon) either in the cambic horizon or below it.

Ustropepts—Moderate to low organic matter content, high level of bases such as calcium, and relatively shallow depth to rock. The soils are moist in some parts for a total of 180 days per year or are continuously moist for 90 days during the growing season.

Umbrepts

Umbrepts are the freely drained Inceptisols that have either an umbric epipedon (thick, dark, acid A horizon) or an ochric epipedon (light-colored A horizon that does not have a high content of organic matter) over a brownish cambic horizon. The soils are moderately to strongly acid and have a low level of bases such as calcium and a moderate to high content of organic matter. The great groups of this suborder and the features characteristic of each are:

Cryumbrepts—Coldest of all the soils in the suborder. The mean annual soil temperature is below 8°C (47°F). The mean soil temperature during the warm season is less than 15°C (59°F).

Fragiumbrepts—A fragipan (subsurface horizon that is compact and brittle but not indurated).

Haplubrepts—Type specimens for the suborder. These soils have an umbric epipedon over the cambic horizon but no extra features. The profile is not dry throughout for 90 days of the year.

Xerumbrepts—Generally an ochric epipedon over a cambic horizon. The soils occur in regions where most of the rain falls during the cool season. The profile is dry throughout for 45 or more consecutive days during the growing season.

Mollisols

Mollisols are extensive in subhumid and semiarid, temperate regions; do not occur in deserts; and are of small extent in humid climates. Land surfaces are chiefly undulating to rolling but some areas are flat, some hilly, and some depressional. The soils are mainly in broad, sweeping plains such as the prairies of North America. Identifying characteristics of Mollisols are: (1) A thick dark A horizon having a high content of humus (mollic epipedon) and (2) a high or moderate level of bases such as calcium throughout the profile. The profiles of many soils are calcareous in some parts, and distinct horizons are at some depth of carbonate accumulations. The order of Mollisols consists of the suborders Albolls, Aquolls, Borolls, Rendolls, Udolls, Ustolls, and Xerolls.

Albolls

Albolls are seasonally wet Mollisols that occur on wide upland flats and in shallow depressions. The soils

have a mollic epipedon, an albic horizon (white or very pale gray subsurface horizon that has lost silicate clays and sesquioxides), and a prominent argillic horizon (B horizon of clay accumulation) that is sometimes called a

claypan. The great groups of this suborder and the features characteristic of each are:

Argialbolls—Type specimens of the suborder.

Natralbolls—A natric horizon (a form of argillic horizon having an appreciable amount of sodium and a distinct prismatic structure).

Aquolls

Aquolls are the wet Mollisols that occur largely in depressions where water stands on the surface for part of the year. They also occur on some upland flats. Most of the soils have a very thick mollic epipedon, but some have a surface layer of peaty materials over a thinner mollic epipedon. The great groups of this suborder and the features characteristic of each are:

Argiaquolls—An argillic horizon (B horizon of silicate clay accumulation).

Calciaquolls—A calcic horizon (horizon of marked accumulation of calcium carbonate) within 40 cm (16 in.) of the soil surface. Many of the soils are calcareous throughout.

Cryaquolls—Coldest of all the soils in the suborder. The mean annual soil temperature is below 8°C (47°F). The mean soil temperature during the warm season is below 15°C (59°F).

Duraquolls—A duripan (silica-cemented horizon) within 1 m (40 in.) of the soil surface.

Haplaquolls—Type specimens for the suborder. These soils have the features required for the suborder and no others.

Natraquolls—A natric horizon (a form of argillic horizon having an appreciable amount of sodium and a distinct prismatic and blocky structure).

Borolls

Borolls are the cold Mollisols of high latitudes and of mountains. They occur in semiarid and subhumid climates. The mean annual soil temperature is below 8°C (47°F). Borolls generally have a black or nearly black mollic epipedon, a brownish B horizon, and a paler C horizon. The great groups of this suborder and the features characteristic of each are:

Argiborolls—An argillic horizon. The upper boundaries are no more, usually less, than 60 cm (24 in.) below the soil surface. The mean annual soil temperature ranges from 0 to 8°C (32 to 47°F). The mean soil temperature during the warm season is 15°C (59°F) or more.

Calciborolls—A calcic horizon (horizon with marked accumulations of carbonates) within 1 m (40 in.) of the soil surface. The mean annual soil temperature ranges from 0 to 8°C (32 to 47°F). The mean soil temperature during the warm season is 15°C (59°F) or more.

Cryborolls—Coldest of all the soils in the suborder. The mean annual soil temperature is below 8°C (47°F). The mean soil temperature during the warm season is below 15°C (59°F).

Haploborolls—Type specimens for the suborder. These soils have the required features for the suborder and no more. The mean annual soil temperature ranges from 0 to 8°C (32 to 47°F). The mean soil temperature during the warm season is 15°C (59°F) or more.

Natriborolls—A natric horizon (a form of argillic horizon having an appreciable amount of sodium and a prominent prismatic structure).

Palebolls—An argillic horizon beginning more than 60 cm (24 in.) below the soil surface.

Vermiborolls—Soils that have been mixed by animals. One-half or more of the mollic epipedon consists of worm and insect casts and filled animal burrows.

Rendolls

Rendolls are Mollisols that formed in highly calcareous regoliths in humid regions. These soils have a mollic epipedon that grades into materials that are almost half calcium carbonate. The moisture regime is udic (profile is not dry in any part for 90 consecutive days a year). No great groups have been defined for this suborder.

Udolls

Udolls are well drained and moderately well drained Mollisols having an udic moisture regime (profile is not dry in any part for 90 consecutive days during a year). Udolls have a very dark brown or brownish-black mollic epipedon, a brown B horizon with or without clay accumulation, and a paler C horizon. The A and B horizons are characteristically acid, but the C horizon may be neutral or slightly alkaline. The great groups of this suborder and the features characteristic of each are:

Argiudolls—An argillic horizon of moderate thickness.

Hapludolls—A brownish cambic horizon (B horizon of alteration and loss). The Hapludolls have the simplest profile of all the soils in the suborder.

Paleudolls—A thick argillic horizon. The percentage of clay in the argillic horizon drops by less than 20 percent of the maximum within 1.5 m (60 in.) of the soil surface.

Vermudolls—Udolls that have been mixed by animals. One-half or more of the mollic epipedon consists of worm casts, worm holes, and filled animal burrows.

Ustolls

Ustolls are the well drained and moderately well drained Mollisols of subhumid and semiarid regions. The moisture regime is predominantly ustic (profile is moist in some parts for 180 days of a year or is continuously moist for 90 days during the growing season). The great groups of this suborder and the features characteristic of each are:

Argiustolls—An argillic horizon (B horizon of silicate clay accumulation) of moderate thickness.

Calciustolls—A calcic or petrocalcic horizon. Overlying horizons are also calcareous but have a lower

content of carbonates. The calcic horizon is within 1 m (40 in.) of the soil surface, and a petrocalcic horizon is within 1.5 m (60 in.).

Durustolls—A duripan (subsurface silica-cemented layer) within 1 m (40 in.) of the soil surface.

Haplustolls—A cambic horizon (subsurface horizon of alteration) or a C horizon immediately beneath a mollic epipedon. These soils have the simplest profile of all the soils in the suborder.

Natrustolls—A natric horizon (a form of argillic horizon having an appreciable amount of sodium and a prominent prismatic structure).

Paleustolls—A thick reddish argillic horizon. The percentage of clay in the argillic horizon drops by less than 20 percent of the maximum within 1.5 m (60 in.) of the soil surface. These soils usually have a petrocalcic horizon within 1.5 m (60 in.) of the soil surface.

Vermustolls—Ustolls that have been mixed by animals. One-half or more of the mollic epipedon consists of worm casts, worm holes, and filled animal burrows.

Xerolls

Xerolls are the Mollisols in regions where most of the rain falls during the cool season. The moisture regime of the soils is xeric (profile is dry in all parts for at least

45 consecutive days during the growing season). The great groups of this suborder and the features characteristic of each are:

Argixerolls—An argillic horizon (B horizon of silicate clay accumulation) of no more than moderate thickness.

Calcixerolls—A calcic horizon (subsurface horizon of marked accumulation of carbonate) within 1.5 m (60 in.) of the soil surface.

Durixerolls—A duripan (subsurface silica-cemented layer) within 1 m (40 in.) of the soil surface.

Haploxerolls—A cambic horizon (subsurface horizon of alteration) or a C horizon immediately beneath a mollic epipedon. Haploxerolls have the simplest profile of all the soils in the suborder.

Natrixerolls—A natric horizon (a form of argillic horizon having an appreciable amount of sodium and a distinct prismatic structure). Horizons having an accumulation of carbonates are commonly below the natric horizon.

Palexerolls—A thick, dark brown or reddish brown argillic horizon that has an abrupt upper boundary. The percentage of clay in the argillic horizon drops by less than 20 percent from the maximum within 1.5 m (60 in.) of the soil surface. These soils have a petrocalcic horizon (subsurface layer cemented by carbonates) within 1.5 m (60 in.) of the soil surface.

Oxisols

Oxisols occur in low latitudes, mostly in the humid Tropics and subtropics. A few occur in arid and semiarid parts of the Tropics. The mean annual soil temperature is largely, but not entirely, above 15°C (59°F). For the most part, land surfaces are level to moderately sloping, but some are strongly sloping. Identifying characteristics of Oxisols are: (1) Faint horizonation (poorly expressed horizons) and an oxic horizon (subsurface horizon consisting of minerals highly resistant to further weathering) with high porosity, (2) friable or very friable consistence, and (3) clay fractions with low capacity to hold bases such as calcium. Freely drained Oxisols have an A horizon about 30 cm (12 in.) thick that is darkened by organic matter. Below this horizon, the profile is uniform to a depth of 2 m (80 in.) or more. Colors are red, yellowish red, brown, or yellowish brown. The order of Oxisols consists of the suborders Aquox, Humox, Orthox, Torrox, and Ustox.

Aquox

Aquox are the wet Oxisols in shallow depressions and on sites receiving seepage water. Plinthite marks the profile of some Aquox, whereas others have gibbsite as aggregates or as cemented sheets. The great groups of this suborder and the features characteristic of each are:

Gibbsiaquox—Cemented sheets or a high percentage of gibbsite gravel within 1 m (40 in.) of the soil surface.

Ochraquox—An ochric epipedon (pale but not white A horizon) over a gray oxic horizon.

Plinthaquox—Plinthite forms a continuous layer within 1.25 m (50 in.) of the soil surface.

Umbraquox—An umbric epipedon (thick, dark, acid A horizon having a relatively high content of organic matter) or a peaty layer at the surface.

Humox

Humox are freely drained Oxisols that are dominantly reddish and have a high content of organic matter and a low level of bases such as calcium. These soils have a dark A horizon. The moisture regime is udic or wetter (no part of the profile is dry for a total of 90 days during a year). The mean annual soil temperature is below 22°C (72°F) but generally is above 15°C (59°F). The great groups of this suborder and the features characteristic of each are:

Acrohumox—Most weathered of all the soils in the suborder.

Gibbsihumox—Cemented sheets or aggregates having a high percentage of gibbsite (hydrated aluminum oxides) within 1 m (40 in.) of the soil surface.

Haplohumox—Least complex profile of all the soils in the suborder. These soils lack features other than those required for the suborder.

Sombrihumox—A sombric horizon (very dark subhorizon) within an oxic horizon.

Orthox

Orthox receive adequate, well-distributed rainfall. The mean annual soil temperature is above 15°C (59°F), generally above 22°C (72°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F. The great groups of this suborder and the features characteristic of each are:

Acrorthox—Most weathered of all the soils of the suborder.

Eutrorthox—The least weathered of all the soils in the suborder. These soils have a relatively high level of bases such as calcium and magnesium.

Gibbsiorthox—Cemented sheets or aggregates having a high percentage of gibbsite (hydrated aluminum oxides) within 1.25 m (50 in.) of the soil surface.

Haplorthox—Simplest profile of all the soils in the suborder.

Sombriorthox—A sombric horizon (very dark subhorizon) within the oxic horizon.

Umbriorthox—An umbric epipedon (thick, dark, acid A horizon having a relatively high proportion of organic matter) or a surface layer having a high content of humus.

Torrox

Torrox are the few Oxisols that occur in arid and

semiarid regions. They are dominantly red and have a low content of organic matter and a relatively high level of bases such as calcium. All known Torrox have a torric moisture regime (all parts of the profile are dry for more than half of a year and are never moist for a total of 90 days). The mean annual soil temperature is above 22°C (72°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F. No great groups have been defined for this suborder.

Ustox

Ustox are freely drained Oxisols occurring in regions having long dry seasons but having enough rain to keep the soil profiles moist for 90 days a year. The mean annual soil temperature is above 15°C (59°F). For most of the Ustox, the difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F. The great groups of this suborder and the features characteristic of each are:

Acrustox—Most weathered of all the soils in the suborder.

Eustrustox—Least weathered of all the soils in the suborder. These soils have a moderate to high level of bases such as calcium and magnesium.

Haplustox—Simplest profile of all the soils in the suborder.

Sombriustox—A sombric horizon (very dark subhorizon) within the oxic horizon.

Spodosols

Spodosols are scattered from the tundra through the Tropics in humid climates. These soils are of greater extent in cold and cool-temperature regions. Land surfaces are mostly undulating to rolling but some are flat, others depressed, and still others hilly. Spodosols have a spodic horizon (B horizon with accumulations of one or more of organic matter, aluminum, or iron). The order of Spodosols consists of the suborders Aquods, Ferrod, Humods, and Orthods.

Aquods

Aquods are the wet Spodosols occurring on wide flats and in low places. These soils are wet much of the time, but the upper part of the soil dries out periodically. The great groups of this suborder and the features characteristic of each are:

Cryaquods—Coldest of all the soils in the suborder. For the most part, the mean annual soil temperature is below 8°C (47°F). Some of the soils have a mean annual soil temperature below 0°C (32°F). The mean soil temperature during the warm season is below 15°C (59°F).

Duraquods—A duripan (silica-cemented layer) in the albic horizon. The mean annual soil temperature is above 0°C (32°F). The mean soil temperature during the warm season is 15°C (59°F) or more.

Fragiaquods—A fragipan (subsurface horizon that is compact and brittle but not indurated) below the spodic horizon. The mean annual soil temperature ranges mainly from 0 to 8°C (32 to 47°F). The mean soil

temperature during the warm season is 15°C (59°F) or more.

Haplaquods—Type specimens for the suborder. These soils have a spodic horizon that is chiefly organic matter and aluminum.

Placaquods—A placic horizon resting on a spodic horizon, a fragipan, or an albic horizon above the spodic horizon.

Sideraquods—Contain much more iron in the spodic horizon than the other soils in the suborder. The mean annual soil temperature is above 0°C (32°F). The mean soil temperature during the warm season is 15°C (59°F) or more.

Tropaquods—Occur in tropical and subtropical regions. These soils formed in sands that are almost pure quartz. In most profiles, a spodic horizon is at a great depth. It is usually black in the upper part and reddish brown below. The mean annual soil temperature is above 8°C (47°F). The difference between the mean soil

temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Ferrodos

Ferrodos are freely drained Spodosols in which the spodic horizon is dominantly iron and contains little organic matter and aluminum. No great groups have been defined for this suborder.

Humods

Humods are the well drained and moderately well drained Spodosols that have a B horizon that has a high content of organic matter, a low content of iron or no iron, and an intermediate level of aluminum. The spodic horizon generally is black throughout or black in the upper part and brown below. The great groups of this suborder and the features characteristic of each are:

Cryohumods—Coldest of all the soils in the suborder. The mean annual soil temperature is below 8°C (47°F). The mean soil temperature during the warm season is below 15°C (59°F).

Fragihumods—A fragipan (compact and brittle horizon that is not indurated) beneath the spodic horizon.

Haplohumods—Type specimens for the suborder. These soils have a spodic horizon that has a high content of organic matter. They have only the horizons and other features required for the suborder. The moisture regime for most Haplohumods is udic (no part of the profile is dry for 90 consecutive days during a year), but a few are xeric (profile is dry throughout at least 45 consecutive days during the growing season). The mean annual soil temperature is above 0°C (32°F). The difference between the mean soil temperature of the warm season and that of the cool season is 5°C or 9°F or more.

Placohumods—A placic horizon (indurated and involuted layer cemented by one or more oxides of iron, mixed oxides of iron and manganese, or iron organic complexes).

Tropohumods—Similar to Haplohumods in morphology and composition, but the mean annual soil temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Orthods

Orthods are the well drained and moderately well drained Spodosols that have about equal accumulations of organic matter, iron, and aluminum in their spodic horizon. The great groups of this suborder and the features characteristic of each are:

Cryorthods—Coldest of all the soils in the suborder. The mean annual soil temperature is less than 8°C (47°F). The mean soil temperature during the warm season is below 15°C (59°F). The coldest Cryorthods have permafrost.

Fragiorthods—A fragipan (compact and brittle horizon that is not indurated) below the spodic horizon.

Haplorthods—Type specimens for the suborder. These soils have the characteristics required for the suborder and lack extra features.

Placorthods—A placic horizon (indurated and involuted layer cemented by one or more oxides of iron, mixed oxides of iron and manganese, or iron organic complexes).

Troporthods—The mean annual temperature is above 8°C (47°F). The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F. The morphology generally is like that of Haplorthods.

Ultisols

Ultisols are major components of soil patterns in humid, warm-temperature regions. They also occur throughout the humid Tropics. The mean annual soil temperature is above 8°C (47°F). Land surfaces are mostly level to hilly, but some Ultisols occur in depressions or on wide flats, and others occur on steep slopes.

Identifying characteristics of Ultisols are: (1) An argillic horizon (B horizon of silicate clay accumulation), (2) a low level of bases such as calcium, and (3) a warm temperature regime. This order consists of the suborders Aquults, Humults, Udults, Ustults, and Xerults.

Aquults

Aquults are the wet Ultisols that occur either in low places or on wide flats. These soils are wet much of the time but dry out for brief periods, at least down into the argillic horizon. Many of these soils also have iron-manganese concretions in their A and B horizons. The great groups of this suborder and the features characteristic of each are:

Albaquults—An argillic horizon having an abrupt upper boundary. Many of these soils also have an albic horizon (white A2 horizon).

Fragiaquults—A fragipan (subsurface horizon that is compact and brittle but not indurated).

Ochraqults—An ochric epipedon (light-colored but not white A2 horizon) set apart from the underlying argillic horizon by a gradual boundary.

Paleaquults—Oldest of all the soils in the suborder. These soils have a thick argillic horizon in which the proportion of clay remains high to a depth of 1.5 m (60 in.) or more.

Plinthaquults—Plinthite forms half or more of some subhorizon in the argillic horizon within 1.25 m (50 in.) of the soil surface.

Tropaquults—Similar to Ochraquults and Umbraquults in morphology and composition, but these soils occur in tropical and subtropical regions. The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Umbraquults—An umbric epipedon (thick, dark, acid A horizon having a high organic matter content) but characteristics otherwise are like those of Ochraquults.

Humults

Humults are the freely drained Ultisols that have a high content of organic matter. Some Humults have an ochric epipedon (light-colored A horizon), and others have an umbric epipedon (thick, dark, acid A horizon having a high content of organic matter). The great groups of this suborder and the features characteristic of each are:

Haplohumults—An argillic horizon of moderate thickness that contains some weatherable minerals.

Palehumults—An argillic horizon of great thickness having few or no weatherable minerals. The percentage of clay in the argillic horizon remains high to a depth of 1.5 m (60 in.).

Plinthohumults—Plinthite forms half or more of some subhorizon in the argillic horizon within 1.25 (50 in.) of the soil surface.

Sombrihumults—A sombric horizon (dark subsurface layer) in the argillic horizon within 1 m (40 in.) of the soil surface.

Tropohumults—Occur in tropical and subtropical regions. The difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F. These soils have a thin argillic horizon, usually red, and a relatively high content of organic matter.

Udults

Udults are well drained and moderately well drained Ultisols having a low content of organic matter and an udic moisture regime (no part of the profile is dry for 90 days a year). The great groups of this suborder and the features characteristic of each are:

Fragiudults—A fragipan (subsurface horizon that is compact and brittle but not indurated).

Hapludults—An argillic horizon of moderate thickness.

Paleudults—An argillic horizon of great thickness that has few or no weatherable minerals. The percentage of clay in the argillic horizon remains high to a depth of 1.5 m (60 in.) below the soil surface.

Plinthudults—Plinthite forms half or more of some subhorizon of the argillic horizon within 1.25 (50 in.) of the soil surface.

Rhodudults—Dark colors throughout the soil profile; the colors may be dark shades of red, reddish brown, or brown.

Tropudults—Occur in regions where the difference between the mean soil temperature of the warm season and that of the cool season is less than 5°C or 9°F.

Ustults

Ustults are freely drained Ultisols that have a low content of organic matter and an ustic moisture regime (some part of the profile is moist for 180 days a year or is continuously moist for 90 days during the growing season). The great groups of this suborder and the features characteristic of each are:

Haplustults—An argillic horizon of moderate thickness. The percentage of clay in the argillic horizon decreases appreciably with depth.

Paleustults—An argillic horizon of great thickness having few or no weatherable minerals. The percentage of clay in the argillic horizon remains high to a depth of 1.5 m (60 in.) below the soil surface.

Plinthustults—Plinthite forms half or more of some subhorizon of the argillic horizon within 1.25 m (50 in.) of the soil surface.

Rhodustults—Dark colors, mostly dark red or dusky red, throughout the profile. The argillic horizon is of moderate thickness.

Xerults

Xerults are freely drained Ultisols that have a low to moderate content of organic matter and a xeric moisture regime (all parts of the profile are dry for 45 consecutive days during the growing season). The mean annual soil temperature ranges from 8 to 22°C (47 to 72°F). The difference between the mean soil temperature of the warm season and that of the cool season is 5°C or 9°F or more. Xerults have an ochric epipedon (light-colored A horizon) and a brownish or reddish argillic horizon. Their total extent is limited. The great groups of this suborder and the features characteristic of each are:

Haploxerults—An argillic horizon of moderate thickness. The percentage of clay in the argillic horizon decreases appreciably with depth.

Palexerults—An argillic horizon of great thickness having few or no weatherable minerals. The percentage of clay in the argillic horizon remains high to a depth of 1.5 m (60 in.) below the soil surface.

Vertisols

Vertisols occur in warm-temperate, subtropical, and tropical regions having one or more long, dry periods each year. The mean annual soil temperature is more than 8°C (47°F). Land surfaces are mostly level to gently sloping but range to strongly sloping and are generally old. Vertisols have a high content of active clay, a low content of organic matter, dull colors, extended periods when little moisture is available, and marked swelling and shrinking with

alternate wetting and drying. During some time each year, cracks several centimeters (1 in. or more) across are either at the soil surface or at the bottom of the plow layer. The order of Vertisols consists of the suborders Torrerts, Uderts, Usterts, and Xererts.

Torrerts

Torrerts occur in arid regions. These soils have cracks that remain open most of the time. The cracks are never closed for more than 60 consecutive days during the warm season. No great groups have been defined for this suborder.

Uderts

Uderts occur in humid regions. Some part of the profile of these soils usually is moist but dries out enough that cracks form at least once in most years but not every year. The great groups of this suborder and the features characteristic of each are:

Chromuderts—A gray or grayish brown A horizon that is only slightly darker, if any, than the material deeper in the profile.

Pelluderts—A black, very dark grayish brown, or very dark gray A horizon that is appreciably darker than the material deeper in the profile.

Usterts

Usterts occur in subhumid regions, chiefly in regions that have two rainy seasons and two dry seasons each year. Cracks form in these soils and remain open for 90

days during the year, but they are closed for at least 60 consecutive days. The great groups of this suborder and the features characteristic of each are:

Chromusterts—A gray or grayish brown A horizon that is only slightly darker, if any, than the material deeper in the profile.

Pellusterts—A black, very dark gray, or very dark grayish brown A horizon that is appreciably darker than the material deeper in the profile.

Xererts

Xererts occur in regions that have warm, dry summers and cool, wet winters. Cracks form in these soils every year and remain open for more than 2 months during the latter part of the warm, dry season. The great groups of this suborder and the features characteristic of each are:

Chromoxererts—A gray or grayish brown A horizon that is only slightly darker, if any, than the material deeper in the profile.

Pelloxererts—A black, very dark gray, or very dark grayish brown A horizon that is appreciably darker than the material deeper in the profile.

Table 2.—Great soil groups in the 1938 classification, as revised in 1959, and their approximate equivalents in the present system of classification

Revised 1938 classification		Present classification	
Great soil groups		Great groups or other taxa mostly included	Great groups or other taxa partly included
Alluvial soils -----		Fluvaquentic and fluventic subgroups of Inceptisols and Mollisols; great groups of Fluvents.	Cryorthents; Cumulic Haploxerolls; entic subgroups of Haploxerolls and Haplustolls; Fluvaquents; great groups of Psamments; Haplaquents; Haplaquepts; Hapludolls.
Alpine Meadow soils -----		Cryaquods -----	Cryaquolls and Cryumbrepts.
Ando soils -----		Dystrandepts -----	Other great groups of Andepts.
Bog soils -----		Great groups of Fibrists, Hemists, and Saprists.	—
Brown soils -----		Mesic families of aridic subgroups of Argiustolls, Argixerolls, Haploxerolls, and Haplustolls; mesic families of ustollic and xerollic subgroups of Argids and Orthids.	Frigid families of xerollic subgroups of Argids, Orthids, and Durixerolls; Aridic Haploborolls.
Brown Forest soils -----		Eutrochrepts -----	Haploxerolls and Hapludolls.
Brown Podzolic soils -----		Cryandepts; mesic families of entic Fragiorthods and Haploorthods.	Dystric Eutrochrepts; Dystrochrepts; Fragiochrepts.
Brunizems (Prairie soils) -----		Mesic families of Argiudolls and Hapludolls; mesic and thermic families of Argixerolls and Haploxerolls.	Cryoborolls; mesic families of Durixerolls, Palexerolls, and udic Argiustolls.
Calcisols -----		Calciborolls, Calciorhids, Calciustolls, Calcixerolls, and Paleorthids.	Camborthids, Durorthids, Ustochrepts, and Xerochrepts.
Calcium Carbonate Solonchaks -----		Calciaquolls -----	Aquic Calciustolls.
Chernozems -----		Cryoborolls; mesic families of typic and udic subgroups of Argiustolls and Haplustolls; udic subgroups of Argiborolls and Haploborolls.	Mesic and frigid families of Haploxerolls.
Chestnut soils -----		Frigid families of Argixerolls, Durixerolls, Haploxerolls, and Palexerolls; mesic families of aridic subgroups of Argiustolls, Argixerolls, Haploxerolls, and Haplustolls; typic subgroups of Argiborolls and Haploborolls.	Aridic subgroups of Argiborolls and Haploborolls; mesic and frigid families of calcic subgroups of Argixerolls and Haploxerolls.
Degraded Chernozems -----		Mollic Eutroboralfs; Haploborolls -----	Boralfic Argiborolls.
Desert soils -----		Mesic families of Durargids, Haplargids, and Paleargids.	Mesic families of Camborthids and Durorthids.
Gray-Brown Podzolic soils -----		Hapludalfs -----	Aeric Ochraqualfs; Fragiudalfs; Glossoboralfs; mesic families of Hapludults.
Gray Wooded soils -----		Eutroboralfs -----	Other great groups of Boralfs.
Ground-Water Laterite soils -----		Plinthaquults, Plinthudults, Plinthustalfs, and Plinthustults.	—
Ground-Water Podzols -----		Great groups of Aquods -----	Haplohumods.
Grumusols -----		Great groups of Vertisols -----	Vertic subgroups of Haplaquepts and Haplaquolls.
Half-Bog soils -----		Histic subgroups of Aquepts -----	Histic subgroups of Aquolls; Umbraqualfs.
Humic Ferruginous Latosols -----		Tropohumults -----	Dystrandepts; great groups of Orthox.
Humic Gley soils -----		Argiaquolls, Cryaquolls, Haplaquolls, Humaquepts, and Umbraquults.	Andaquepts, Calciaquolls, Fluvaquents, Mollic Haplaquepts, and Mollic Ochraqualfs.
Humic Latosols -----		Tropohumults -----	Dystrandepts, Gibbsumox, and Hydrandepts.
Hydrol Humic Latosols -----		Hydrandepts.	—
Laterite soils -----		Acrothox.	—
Latosolic Brown Forest soils -----		Dystrandepts -----	Vitrandepts.
Latosols (great groups of) -----		Humoxic Tropohumults; Tropepts -----	Great groups of Oxisols; Hydrandepts; Rhodustults.

**Table 2.—Great soil groups in the 1938 classification, as revised in 1959,
and their approximate equivalents in the present system of classification—Continued**

Revised 1938 classification		Present classification	
Great soil groups	Treat groups or other taxa mostly included	Great groups or other taxa partly included	
Lithosols -----	Lithic subgroups; shallow families of Orthents.	Lithic subgroups and shallow families of Alfisols, Aridisols, Inceptisols, Mollisols, Ultisols, and other Entisols.	
Low-Humic Gley soils -----	Great groups of Aquults; Haplaquents; Haplaquepts; and Ochraqualfs.	Cryaquents; Fluvaquents; other great groups of Aquepts and Aqualfs; Psammaquents.	
Low Humic Latosols -----	Ustropepts -----	Haplustox.	
Noncalci Brown soils -----	Durixeralfs, Haploxeralfs, and Palexeralfs.	Xerochrepts.	
Planosols -----	Albaqualfs, Argialbolls, Fragiaqualfs, and Glossaqualfs.	Fragiaquults; Albaquults.	
Podzol soils -----	Cryorthods, Fragiorthods, and Haplorthods.	Haplohumods.	
Prairie soils -----	(See Brunizems) -----	(See Brunizems).	
Red Desert soils -----	Thermic and hyperthermic families of Camborthids, Durargids, Haplargids, and Paleargids.	Thermic and hyperthermic families of Calciorthids.	
Reddish-Brown Lateritic soils -----	Great groups of Humults; rhodic subgroups of Paleudalfs and Paleudults; Rhodudults.	—	
Reddish Brown soils -----	Haplustalfs; Paleustalfs; thermic and hyperthermic families of typic and ustollic subgroups of Calciorthids, Camborthids, and Haplargids.	Isothermic and isohyperthermic families of Eutrandepts; thermic and hyperthermic families of aridic Argiustolls, Calciustolls, and Haplustolls.	
Reddish Chestnut soils -----	Haplustalfs; Paleustalfs; thermic and hyperthermic families of aridic and typic subgroups of Argiustolls and Paleustolls.	Thermic and hyperthermic families of Haplustolls.	
Reddish Prairie soils -----	Thermic families of udic subgroups of Argiustolls and Paleustolls.	Isothermic and isohyperthermic families of Eutrandepts; thermic families of Paleudolls.	
Red-Yellow Podzolic soils -----	Thermic families of Fragiudults, Hapludults, and Paleudults.	Mesic families of Fragiudults, Hapludults, and Paleudults; thermic families of Paleudalfs; thermic families of ultic subgroups of Haplustalfs and Paleustalfs.	
Regosols -----	Great groups of Psamments; subgroups of Orthents other than lithic; Vitrandepts.	Entic subgroups of Haploxerolls, Hapludolls, and Haplustolls; Grossarenic Paleudults; Psammaquents; Xerochrepts.	
Rendzina soils -----	Rendolls -----	Calciustolls, Hapludolls, and Haplustolls.	
Sierozems -----	Mesic and frigid families of ustollic and xerollic subgroups of Camborthids; Durargids, Haplargids, and Paleargids.	—	
Solonchak soils -----	Salorthids -----	Halaquepts.	
Solonetz soils -----	Natric great groups of Alfisols, Aridisols, and Mollisols.	—	
Soloth soils -----	-----	Natraqualfs; natric subgroups of Cryoborolls, Duraquolls, Durixeralfs, and Haploxeralfs.	
Sols Bruns Acides -----	Dystrochrepts, Fragiochrepts, and Haplumbrepts.	Udorthents and Xerumbrepts.	
Subarctic Brown Forest soils -----	Cryochrepts -----	Cryoborolls.	
Tundra soils -----	Pergelic Cryaquepts -----	Cryandepts, Cryochrepts, and Cryumbrepts.	
Yellowish-Brown Lateritic soils ¹			

¹Combined with Reddish-Brown Lateritic soils in 1949.
Source: USDA Agriculture Handbook 436.

APPENDIX III. CARIBBEAN REGION

Appendix III describes the major physical characteristics of the Caribbean land resource region (designated by the capital letter *Z*) and major land resource areas (see p. 154).

Z—CARIBBEAN REGION

The Caribbean Region includes Puerto Rico, the adjacent islands (Vieques, Culebra, and Mona), and the U. S. Virgin Islands (St. Croix, St. Thomas, and St. John).

Puerto Rico is surrounded by the Atlantic Ocean in the north and by the Caribbean Sea in the south. Approximately three-fourths of the island consists of mountain ranges. Cerro de Punta, the highest peak, is 1,338 m high, and the elevation of El Yunque is 1,065 m. Other prominent physical features are limestone karst in the northwest and coastal plains of varying width along the northern and southern coasts. In about 15 percent of the Caribbean Region, slopes are 15 percent or less; in 25 percent, slopes range from 16 to 45 percent; and in the rest of the region, they are more than 45 percent.

Average annual precipitation ranges from 2,100 mm in the humid uplands, 1,600 mm in the humid coastal plains, 1,150 mm in the semiarid mountains and valleys, to 900 mm in the semiarid coastal plains. The average annual temperature is 24°C in the humid uplands, 25°C in the humid coastal plains, 26°C in the semiarid mountains and valleys, and 26°C in the semiarid coastal plains.

The soils in the Caribbean Region are extremely variable and complex. Tropepts and Humults are the principal soils in the mountainous areas, and Udults and Orthox are dominant on coastal plains. The poorly drained Aquepts, Aquolls, and Aquepts are common on flood plains, and Ustolls and Udolls are on the better drained sites. Rendolls and Udalfs occur in areas of limestone karst. Principal limiting characteristics of the soils in this region are shallowness to bedrock and steepness of slope.

Forest is the climax vegetation. The importance of sugarcane, once the main cash crop, has declined because many sugar mills have been closed because of inefficiency and high labor costs. Coffee grown under shade was once a prosperous enterprise, but hurricanes and labor problems have contributed to its decline. Pasture of native and improved grasses grown for dairy and beef enterprises is the main land use. Woodland, mostly unimproved, is widespread, especially on the humid uplands. Such food crops as plantains, bananas, yams, taniens, vegetables, and some citrus fruit and coconuts are grown. Some unique farmland is used for growing pineapples and rice.

Urban developments, highways, and recreation sites are encroaching upon the better farmland, especially near the metropolitan areas.

270—Humid Mountains and Valleys

Puerto Rico
4,910 km² (1,895 mi²)

Land use: Most of this area is in farms. About 70 percent is pasture of improved forage and native grasses. Approximately 10 percent of the area is planted to coffee. Most of the coffee is grown in the shade, but some is grown in the sun. About 7 percent of the area is ungrazed forests. The remainder is used for growing such food crops as plantains, bananas, taniens, yams, and pigeon peas and for orchards and other purposes. Urban expansion is not a significant land use problem. Forest is the climax vegetation.

Elevation and topography: Elevation ranges from 50 to 1,340 m. Three distinct mountain ranges are in the area. The Central Ridge, Cordillera Central as it is known locally, is the highest and largest of the three. It is oriented in a general east-west direction. Cerro de Punta, its highest peak, is 1,338 m above sea level. Los Tres Picachos and Monte Guilarte are

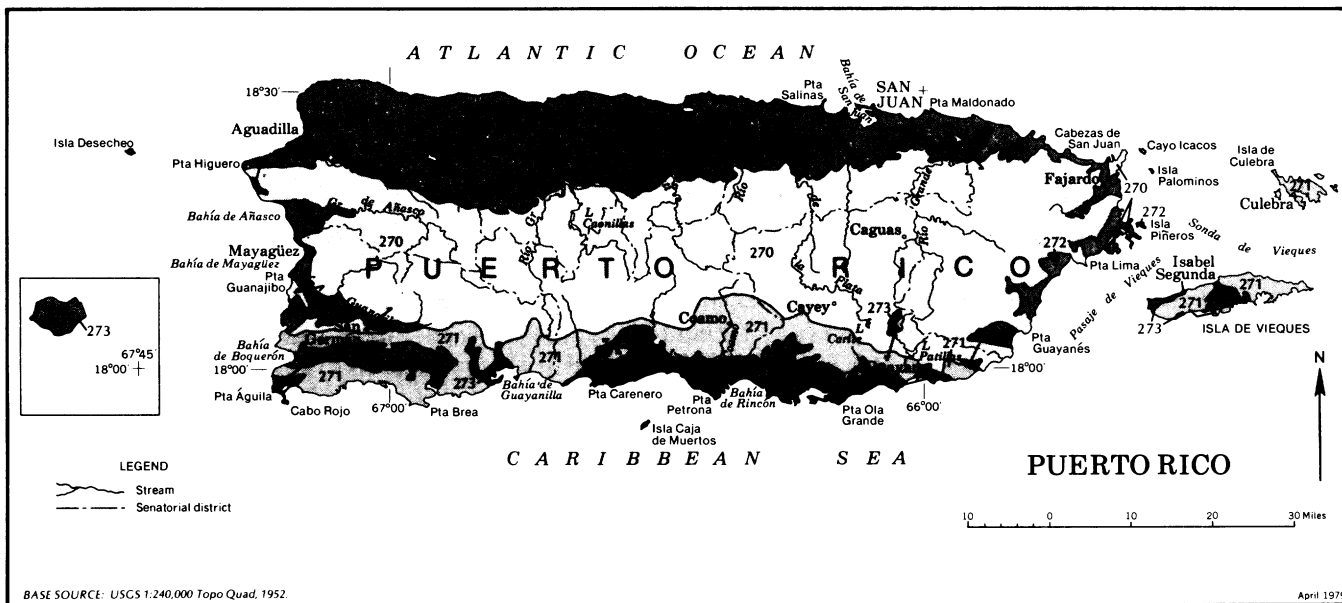
about 1,205 m high. Second in extent and elevation is the Sierra de Luquillo in the northeastern part of Puerto Rico. The three highest peaks are El Toro, 1,074 m above sea level; El Yunque, 1,065 m; and Pico del Este, 1,051 m. The third range is the Sierra de Cayey in the east-central part of Puerto Rico. The Cerro La Santa, 903 m high, and Cerro La Tabla, 890 m high, are the highest peaks of this range.

Climate: *Average annual precipitation*—2,075 to 2,150 mm. Maximum precipitation is in May and in September. *Average annual temperature*—24°C. There is little difference between the temperature in summer and that in winter.

Water: Surface water from precipitation, perennial streams, and lakes is abundant. Ground water is limited to water that seeps into the soil and is stored in the dense and massive underlying volcanic rock.

Soils: Most of the soils are Tropepts and Humults. Shallow and moderately deep, medium textured Eutropepts (Caguabo, Mucara, Quebrada, and Morado series) have an isohyperthermic temperature regime

MAJOR LAND RESOURCE AREAS OF PUERTO RICO AND THE VIRGIN ISLANDS

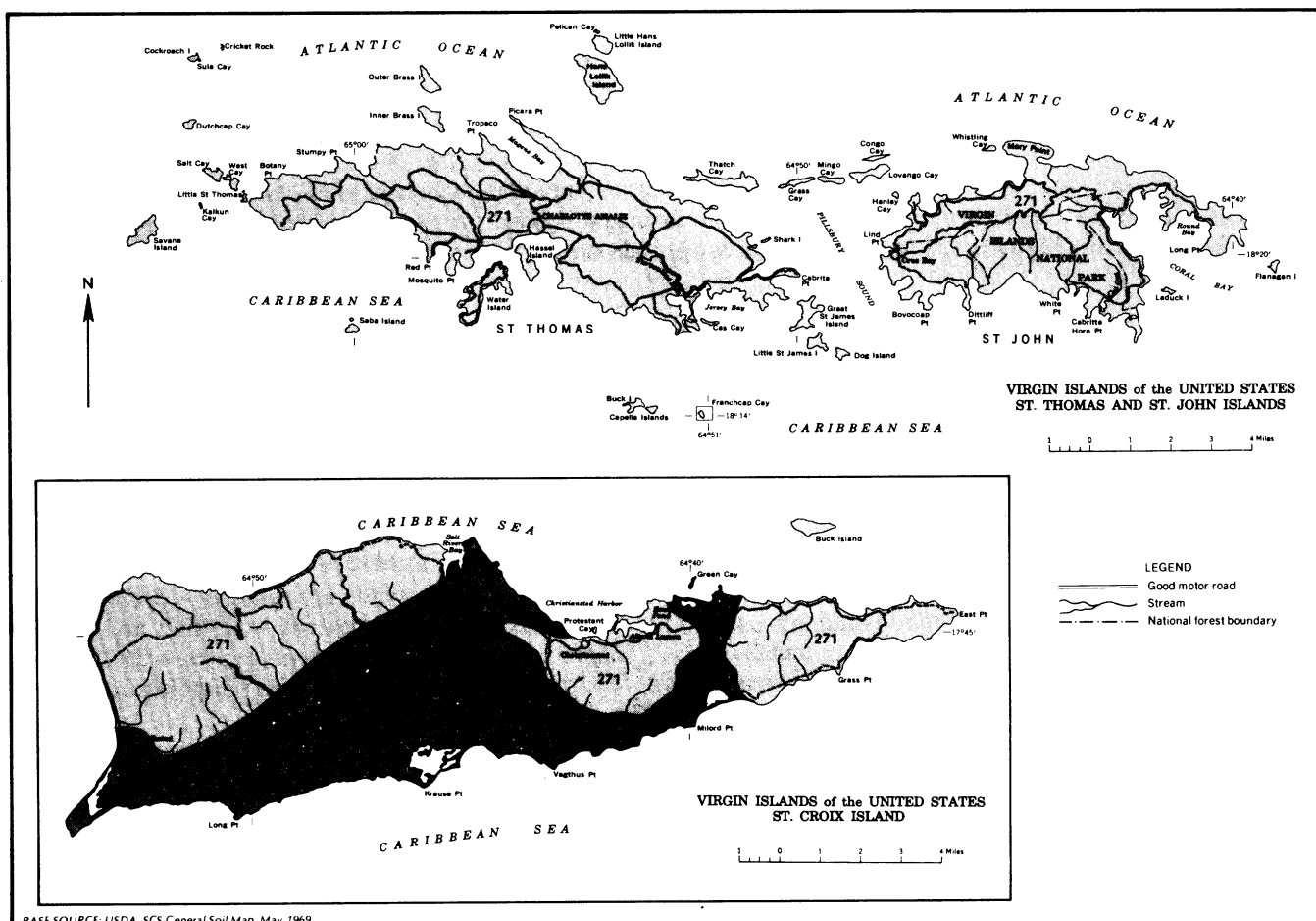


Z - CARIBBEAN

- 270** Humid Mountains and Valleys
- 271** Semi-arid Mountains and Valleys

- 272** Humid Coastal Plains
- 273** Semi-arid Coastal Plains

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and mixed mineralogy. They are on steep side slopes, mainly in the east-central part of Puerto Rico. Deep, fine textured Trophepts (Humatas and Los Guineos series) have isohyperthermic and isothermic temperature regimes and kaolinitic and oxidic mineralogy. They are on steep side slopes in the west-central part of Puerto Rico. Soils of minor extent are the deep, extremely weathered Acrorthox (Nipe series) in the western part of Puerto Rico.

271—Semiarid Mountains and Valleys

Puerto Rico, Outlying Islands, and U.S. Virgin Islands

Puerto Rico—960 km² (369 mi²)

U.S. Virgin Islands—220 km² (85 mi²)

Land use: Most of this area in Puerto Rico is in farms.

About 60 percent is pasture, mainly of native adapted grasses. About 35 percent is natural forest, about 10 percent of which is in improved species of such hardwoods as mahogany, teak, cadam, and eucalyptus. Urban expansion is not a land use problem. The mountainous region in northwestern St. Croix, the largest of the U.S. Virgin Islands, supports a fairly dense tropical forest. In other parts there is a dense growth of thorny bushes and cacti, which generally grow in semiarid regions having low rainfall and high evaporation. Although the soils in the Virgin Islands have severe limitations that preclude their use for dwellings, urban development is significant.

Elevation and topography: Elevation in Puerto Rico ranges from 50 to 400 m. Slopes range from moderately steep to very steep; near-vertical slopes occur in the northernmost part of the area. These semiarid mountains are in the southern slopes of the central mountain chain that runs east and west the length of the island. All streams in the Puerto Rican part of this area flow to the south. The U.S. Virgin Islands are mountainous. St. Croix is characterized by a ridge of mountains in the north flanked by a rolling plain to the south. Mount Eagle, the highest peak in St. Croix, is 355 m high. St. Thomas and St. John are characterized by irregular coastlines, many bays, steep slopes, and small drainage areas. Crown Mountain, the highest peak in St. Thomas, is 457 m above sea level. Bordeaux Mountain, the highest peak in St. John, is 390 m above sea level.

Climate: *Average annual precipitation*—1,150 mm. Maximum precipitation is in May and in September. *Average annual temperature*—26°C. The difference between the temperature in summer and that in winter is less than 5°C.

Water: The source of surface water is about 1,143 mm of rainfall a year. Because of high evaporation rates in this area, much of this precipitation is lost in the atmosphere before reaching the small streams and rivers. The few manmade lakes are used for storing water for human consumption and for irrigation. Ground water is scarce because the steep topography

and the high evaporation rates prevent sufficient quantities of water from entering the soil and establishing underground deposits.

Soils: Most of the soils are Trophepts. They are shallow and moderately deep and medium textured. They have an isohyperthermic temperature regime and mixed mineralogy on volcanic rocks. The well-drained, shallow Ustrophepts (Descalabrado series) are dominant throughout the area and are on the steep southern side slopes of the east-west central ridge of mountains. The well-drained, moderately deep Ustrophepts (Callabo and Jacana series) are on side slopes and foot slopes. Of minor extent are shallow, well-drained Haplustalfs (Guayama series) on steep side slopes.

272—Humid Coastal Plains

Puerto Rico

2,420 km² (933 mi²)

Land use: Most of this area is in farms averaging 35 acres. Pasture of native and improved grasses make up nearly 50 percent of the area. Many large dairy farms are in the Humid Coastal Plains. About 17 percent of the acreage is cropland, and sugarcane is the chief cash crop. About 7,000 acres of unique farmland is planted to pineapples on Oxisols. Rice production is a new agricultural enterprise. Orchards, mainly orange trees; grapefruit; and coconut are important in some locations. Urban development is significant, especially around the large metropolitan section, and contributes to a serious land use problem.

Elevation and topography: Elevation ranges from sea level to 700 m, rising gradually from the beaches on the Atlantic Ocean to the hilly karst area to the south. This area is divided into two distinct zones—the flat alluvial plains and terraces along the coast and the irregular features of the karst limestone inland. Streams generally flow to the north, but most of the drainage in the karst zone is underground.

Climate: *Average annual precipitation*—1,600 mm. Maximum precipitation is in May and August. *Average annual temperature*—25°C. There is little difference between the temperature in summer and that in winter.

Water: Surface and ground water are plentiful. Surface water consists of runoff from rainfall in the humid uplands. Some large manmade lakes are used for hydroelectric power and as a source of water for human consumption. Ground-water supplies are derived from water in the joints and fractures of the underlying volcanic rock and the contiguous limestone aquifers of this humid coastal area.

Soils: There are four distinct geomorphic areas—coastal plains, river flood plains, small lagoonlike depressions, and limestone karst areas. All the soils have an isohyperthermic temperature regime. In the coastal

plains, the dominant soils are deep, well-drained, acid Paleudults (Almirante, Aceitunas, and Vega Alta series) and Haplorthox (Coto and Bayamon series). On the flood plains, the poorly drained Tropaquepts (Bajura series), the somewhat poorly drained Fluvaquents (Coloso series), and the well-drained Hapludolls (Toa series) are the main soils. Poorly drained Troposaprists (Tiburones, Palmas Altas, and Saladar series), Fluvaquents (Martín Peña series), and swamps and marshes are dominant in small depressions. In the extensive limestone karst, Rendolls (Colinas and Soller series) and Tropudalfs (Tanaña and San Sebastián series) are major soils.

273—Semiarid Coastal Plains

Puerto Rico, Outlying Islands, and U.S. Virgin Islands

Puerto Rico—580 km² (223 mi²)

U.S. Virgin Islands—120 km² (48 mi²)

Land use: Most of the Puerto Rican part of this MLRA is in farms. More than 50 percent is pasture of native and improved grasses used mainly for beef production. The production of hay for race horses is an important enterprise in some locations. More than 80,000 acres are under different systems of irrigation, mainly for sugarcane production. Several hundred acres are drip irrigated for the production of avocados, mangoes, and oranges. Growing vegetables under irrigation is becoming of local economic importance. Urban expansion is a land use problem near the larger cities of Puerto Rico. For many years the sugarcane grown in St. Croix was an important part of the economy, but the sugar mills have been closed, and it has been difficult to find a suitable cash crop because of the scarcity of water for irrigation. Rapid urban expansion has increased the need for new roads, schools, and recreation developments.

Elevation and topography: Elevation in the Puerto

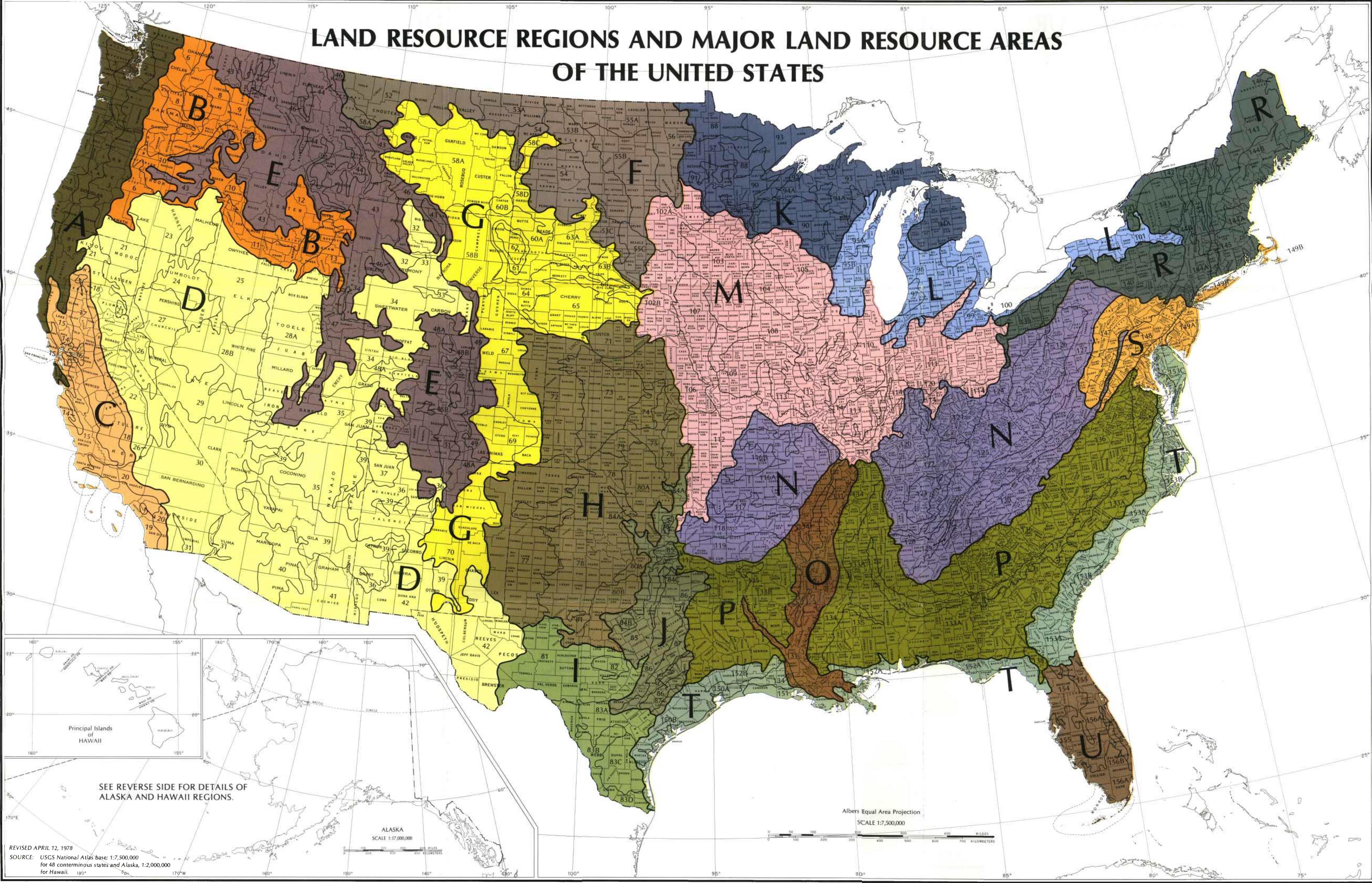
Rican part of this area ranges from sea level to 400 m. Most of the area is nearly level to gently sloping. Elevation increases gradually from the beaches on the Caribbean Sea to the foothills of the semiarid mountains to the north. Limestone hills and ridges are similar to those in the Humid Coastal Plains, but they lack the striking karst features. All drainage is surficial and flows in a southerly direction. On the Island of St. Croix, of the U.S. Virgin Islands, mountains are broken by nearly level to gently sloping alluvial fans, flood plains, foot slopes, and low rolling limestone hills.

Climate: *Average annual precipitation*—900 mm. Maximum precipitation is in May and in September. *Average annual temperature*—26°C. The difference between the temperature in summer and that in winter is small.

Water: Surface water is scarce because of limited rainfall and high evaporation rates. Low rainfall and the steep topography of the adjacent semiarid mountains to the north provide little additional surface water. Streams and rivers generally are intermittent. Aquifers are affected by saltwater intrusion because of overuse. In places artesian pressure brings saline and sodic ground water to the surface. Three organized irrigation districts are in southern Puerto Rico, but there are none in the U.S. Virgin Islands.

Soils: Aquolls, Ustolls, and Usterts are the dominant soils on flood plains and on high terraces. These soils have an isohyperthermic temperature regime and mixed or montmorillonitic mineralogy. On the flood plains, deep, somewhat poorly drained, fine textured Calciaquolls (Constancia series) and well-drained Haplustolls (Jacaguas and San Antón series) are dominant. On the high terraces, deep expansive clayey Chromusterts (Fraternidad and Paso Seco series) and Pellusterts (Aguirre and Guanica series) are dominant.

LAND RESOURCE REGIONS AND MAJOR LAND RESOURCE AREAS OF THE UNITED STATES



- A** NORTHWESTERN FOREST, FORAGE, AND SPECIALTY CROP REGION
- 1 Northern Pacific Coast Range, Foothills, and Valleys
 - 2 Willamette and Puget Sound Valleys
 - 3 Olympic and Cascade Mountains, Western Slope
 - 4 California Coastal Redwood Belt
 - 5 Siskiyou-Trinity Area
- B** NORTHWESTERN WHEAT AND RANGE REGION
- 6 Cascade Mountains, Eastern Slope
 - 7 Columbia Basin
 - 8 Columbia Plateau
 - 9 Palouse and Nez Perce Prairies
 - 10 Upper Snake River Lava Plains and Hills
 - 11 Snake River Plains
 - 12 Lost River Valleys and Mountains
 - 13 Eastern Idaho Plateaus
- C** CALIFORNIA SUBTROPICAL FRUIT, TRUCK, AND SPECIALTY CROP REGION
- 14 Central California Coastal Valleys
 - 15 Central California Coast Range
 - 16 California Delta
 - 17 Sacramento and San Joaquin Valleys
 - 18 Sierra Nevada Foothills
 - 19 Southern California Coastal Plain
 - 20 Southern California Mountains
- D** WESTERN RANGE AND IRRIGATED REGION
- 21 Klamath and Shasta Valleys and Basins
 - 22 Sierra Nevada Range
 - 23 Malheur High Plateau

- 24 Humboldt Area
 - 25 Owyhee High Plateau
 - 26 Carson Basin and Mountains
 - 27 Fallon-Lovelock Area
 - 28A Great Salt Lake Area
 - 28B Central Nevada Basin and Range
 - 29 Southern Nevada Basin and Range
 - 30 Sonoran Basin and Range
 - 31 Imperial Valley
 - 32 Northern Intermountain Desert Basins
 - 33 Semiarid Rocky Mountains
 - 34 Central Desertic Basins, Mountains, and Plateaus
 - 35 Colorado and Green River Plateaus
 - 36 New Mexico and Arizona Plateaus and Mesas
 - 37 San Juan River Valley Mesas and Plateaus
 - 38 Arizona and New Mexico Mountains
 - 39 Central Arizona Basin and Range
 - 40 Southeastern Arizona Basin and Range
 - 41 Southern Desertic Basins, Plains, and Mountains
 - 42 48A (See E)
- E** ROCKY MOUNTAIN RANGE AND FOREST REGION
- 43 Northern Rocky Mountains
 - 44 Northern Rocky Mountain Valleys
 - 45 Northern Rocky Mountain Foothills
 - 46 Wasatch and Uinta Mountains
 - 47A Southern Rocky Mountains
 - 47B Southern Rocky Mountain Parks
 - 48 Southern Rocky Mountain Foothills
 - 49 High Intermountain Valleys
- F** NORTHERN GREAT PLAINS SPRING WHEAT REGION
- 50 Brown Glaciated Plain
 - 51 53A Northern Dark Brown Glaciated Plains
 - 52 53B Central Dark Brown Glaciated Plains

- 53C Southern Dark Brown Glaciated Plains
 - 54 Rolling Soft Shale Plain
 - 55A Northern Black Glaciated Plains
 - 55B Central Black Glaciated Plains
 - 55C Southern Black Glaciated Plains
 - 56 Red River Valley of the North
 - 57 (See K)
 - 58A (See G)
- G** WESTERN GREAT PLAINS RANGE AND IRRIGATED REGION
- 58A Northern Rolling High Plains, Northern Part
 - 58B Northern Rolling High Plains, Southern Part
 - 58C Northern Rolling High Plains, Northeastern Part
 - 58D Northern Rolling High Plains, Eastern Part
 - 60A Pierre Shale Plains and Badlands
 - 60B Pierre Shale Plains, Northern Part
 - 61 Black Hills Foothills
 - 62 Black Hills
 - 63A Northern Rolling Pierre Shale Plains
 - 63B Southern Rolling Pierre Shale Plains
 - 64 Mixed Sandy and Silty Tableland
 - 65 Nebraska Sand Hills
 - 66 Dakota-Nebraska Eroded Tableland
 - 67 Central High Plains
 - 68 Upper Arkansas Valley Rolling Plains
 - 69 Pecos-Canadian Plains and Valleys
- H** CENTRAL GREAT PLAINS WINTER WHEAT AND RANGE REGION
- 71 Central Nebraska Loess Hills
 - 72 Central High Tableland
 - 73 Rolling Plains and Breaks
 - 74 Central Kansas Sandstone Hills
 - 75 Central Loess Plains
 - 76 Bluestem Hills
 - 77 Southern High Plains
 - 78 Central Rolling Red Plains

- 79 Great Bend Sand Plains
 - 80A Central Rolling Red Prairies
 - 80B Texas North Central Prairies
 - 81 (See I)
- I** SOUTHWEST PLATEAUS AND PLAINS RANGE AND COTTON REGION
- 81 Edwards Plateau
 - 82 Texas Central Basin
 - 83A Northern Rio Grande Plain
 - 83B Western Rio Grande Plain
 - 83C Central Rio Grande Plain
 - 83D Lower Rio Grande Valley
- J** SOUTHWESTERN PRAIRIES COTTON AND FORAGE REGION
- 80A (See H)
 - 84A Cross Timbers
 - 84B West Cross Timbers
 - 84C East Cross Timbers
 - 85 Grand Prairie
 - 86 Texas Blackland Prairie
 - 87 Texas Claypan Area
- K** NORTHERN LAKE STATES FOREST AND FORAGE REGION
- 57 Northern Minnesota Cray Drift
 - 88 Northern Minnesota Glacial Lake Basins
 - 90 Central Wisconsin and Minnesota Thin Loess and Till
 - 91 Wisconsin and Minnesota Sandy Outwash
 - 92 Superior Lake Plain
 - 93 Superior Stony and Rocky Loamy Plains and Hills
 - 94A Northern Michigan and Wisconsin Sandy Drift
 - 94B Michigan Eastern Upper Peninsula Sandy Drift

- L** LAKE STATES FRUIT, TRUCK, AND DAIRY REGION
- 95A Northeastern Wisconsin Drift Plain
 - 95B Southern Wisconsin and Northern Illinois Drift Plain
 - 96 Western Michigan and Northeastern Wisconsin Fruit Belt
 - 97 Southwestern Michigan Fruit and Truck Belt
 - 98 Southern Michigan and Northern Indiana Drift Plain
 - 99 Erie-Huron Lake Plain
 - 100 Erie Fruit and Truck Area
 - 101 Ontario Plain and Finger Lakes Region
- M** CENTRAL FEED GRAINS AND LIVESTOCK REGION
- 102A Rolling Till Prairie
 - 102B Loess Uplands and Till Plains
 - 103 Central Iowa and Minnesota Till Prairies
 - 104 Eastern Iowa and Minnesota Till Prairies
 - 105 Northern Mississippi Valley Loess Hills
 - 106 Nebraska and Kansas Loess-Drift Hills
 - 107 Iowa and Missouri Deep Loess Hills
 - 108 Illinois and Iowa Deep Loess and Drift
 - 109 Iowa and Missouri Heavy Till Plain
 - 110 Northern Illinois and Indiana Heavy Till Plain
 - 111 Indiana and Ohio Till Plain
 - 112 Cherokee Prairies
 - 113 Central Claypan Areas
 - 114 Southern Illinois and Indiana Thin Loess and Till Plain
 - 115 Central Mississippi Valley Wooded Slopes
- N** EAST AND CENTRAL FARMING AND FOREST REGION
- 116A Ozark Highland
 - 116B Ozark Border
 - 117 Boston Mountains
 - 118 Arkansas Valley and Ridges

- 119 Ouachita Mountains
 - 120 Kentucky and Indiana Sandstone and Shale Hills and Valleys
 - 121 Kentucky Bluegrass
 - 122 Highland Rim and Pennyroyal
 - 123 Nashville Basin
 - 124 Western Allegheny Plateau
 - 125 Cumberland Plateau and Mountains
 - 126 Central Allegheny Plateau
 - 127 Eastern Allegheny Plateau and Mountains
 - 128 Southern Appalachian Ridges and Valleys
 - 129 Sand Mountain
 - 130 Blue Ridge
- O** MISSISSIPPI DELTA COTTON AND FEED GRAINS REGION
- 131 Southern Mississippi Valley Alluvium
 - 134 (See P)
- P** SOUTH ATLANTIC AND GULF SLOPE CASH CROPS, FOREST, AND LIVESTOCK REGION
- 112 (See M)
 - 132 Southern Coastal Plain
 - 133B Western Coastal Plain
 - 134 Southern Mississippi Valley Silty Uplands
 - 135 Alabama, Mississippi, and Arkansas Blackland Prairie
 - 136 Southern Piedmont
 - 137 Carolina and Georgia Sand Hills
 - 138 North Central Florida Ridge
- R** NORTHEASTERN FORAGE AND FOREST REGION
- 139 Eastern Ohio Till Plain
 - 140 Glaciated Allegheny Plateau and Catskill Mountains
 - 141 Tuglihu Plateau

- 142 St. Lawrence-Champlain Plain
 - 143 Northeastern Mountains
 - 144A New England and Eastern New York Upland, Southern Part
 - 144B New England and Eastern New York Upland, Northern Part
 - 145 Connecticut Valley
 - 146 Aroostook Area
- S** NORTHERN ATLANTIC SLOPE DIVERSIFIED FARMING REGION
- 147 Northern Appalachian Ridges and Valleys
 - 148 Northern Piedmont
 - 149A Northern Coastal Plain
 - 149B Long Island-Cape Cod Coastal Lowland
- T** ATLANTIC AND GULF COAST LOWLAND FOREST AND CROP REGION
- 150A Gulf Coast Prairies
 - 150B Gulf Coast Saline Prairies
 - 151 Gulf Coast Marsh
 - 152A Eastern Gulf Coast Flatwoods
 - 152B Western Gulf Coast Flatwoods
 - 153A Atlantic Coast Flatwoods
 - 153B Tidewater Area
 - 153C Mid-Atlantic Coastal Plain
- U** FLORIDA SUBTROPICAL FRUIT, TRUCK CROP, AND RANGE REGION
- 154 South-Central Florida Ridge
 - 155 Southern Florida Flatwoods
 - 156A Florida Everglades and Associated Areas
 - 156B Southern Florida Lowlands

Areas 38, 45, 50, 68, 89, and 132, shown on the 1965 edition, are no longer separate major land resource areas.

LAND RESOURCE REGIONS AND MAJOR LAND RESOURCE AREAS OF THE UNITED STATES

- W

SOUTHERN ALASKA REGION

168

Southeastern Alaska

169

South-Central Alaska Mountains

170

Cook Inlet-Susitna Lowland

171

Alaska Peninsula and Southwestern Islands
- X

INTERIOR ALASKA REGION

172

Copper River Plateau

173

Alaska Range

174

Interior Alaska Lowlands

175

Kuskokwim Highlands

176

Interior Alaska Highlands
- Y

ARCTIC AND WESTERN ALASKA REGION

177

Norton Sound Highlands

178

Western Alaska Coastal Plains and Deltas

179

Bering Sea Islands

180

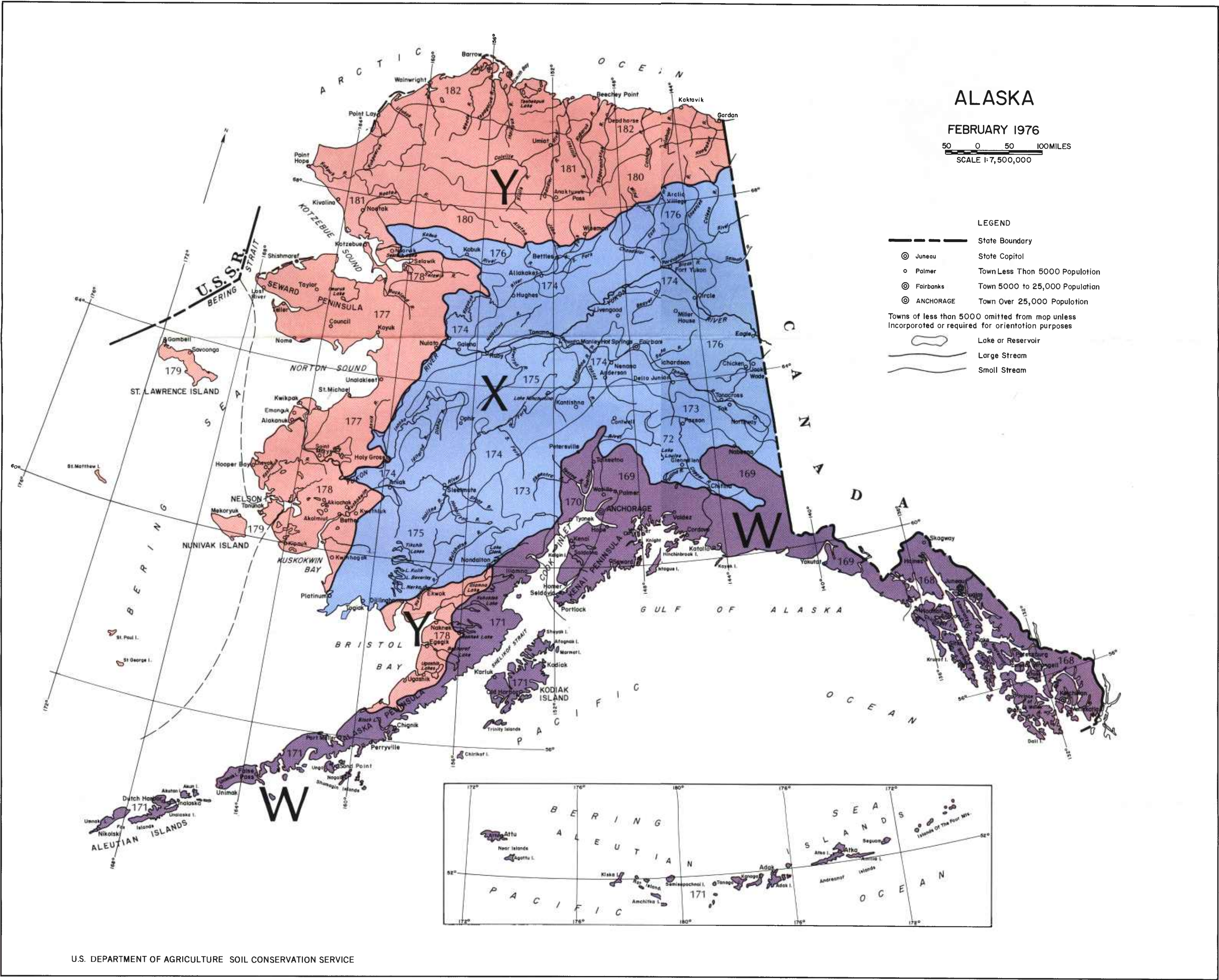
Brooks Range

181

Arctic Foothills

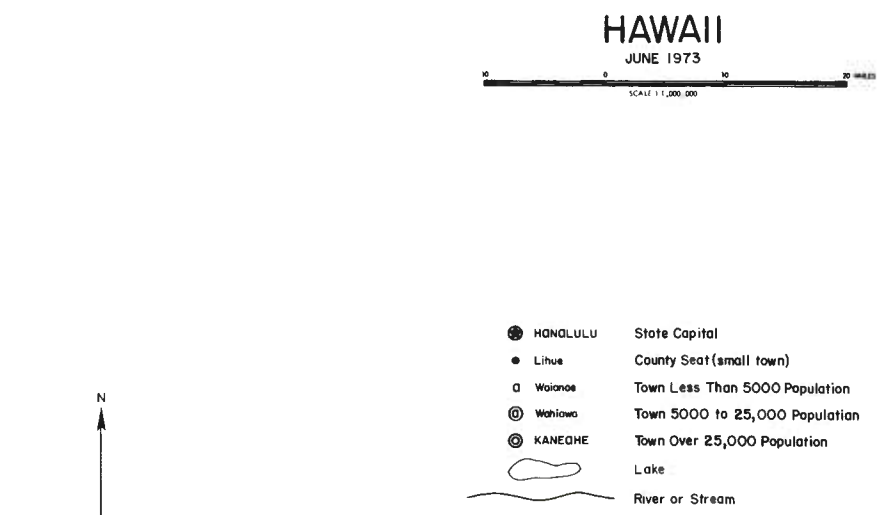
182

Arctic Coastal Plain

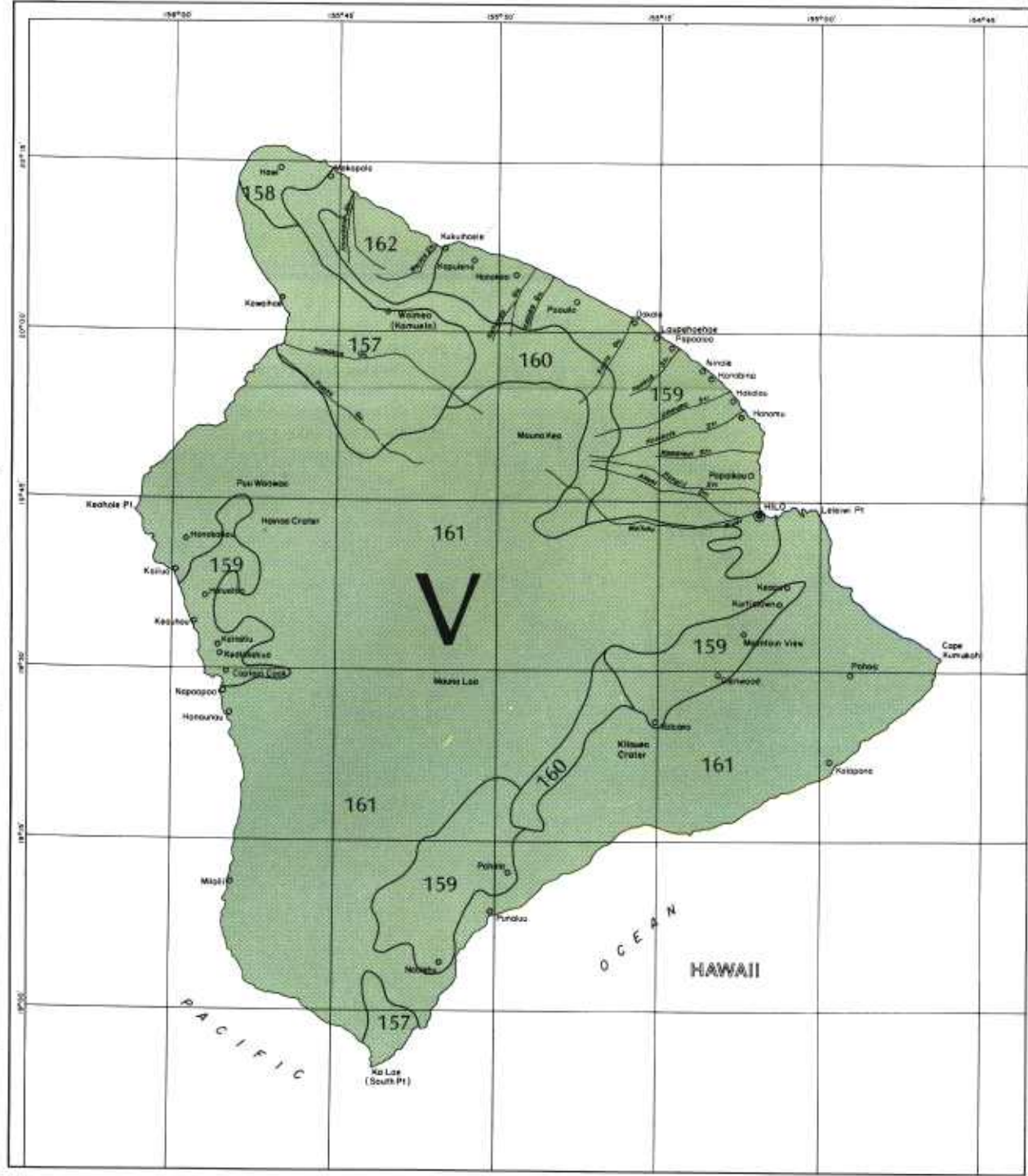
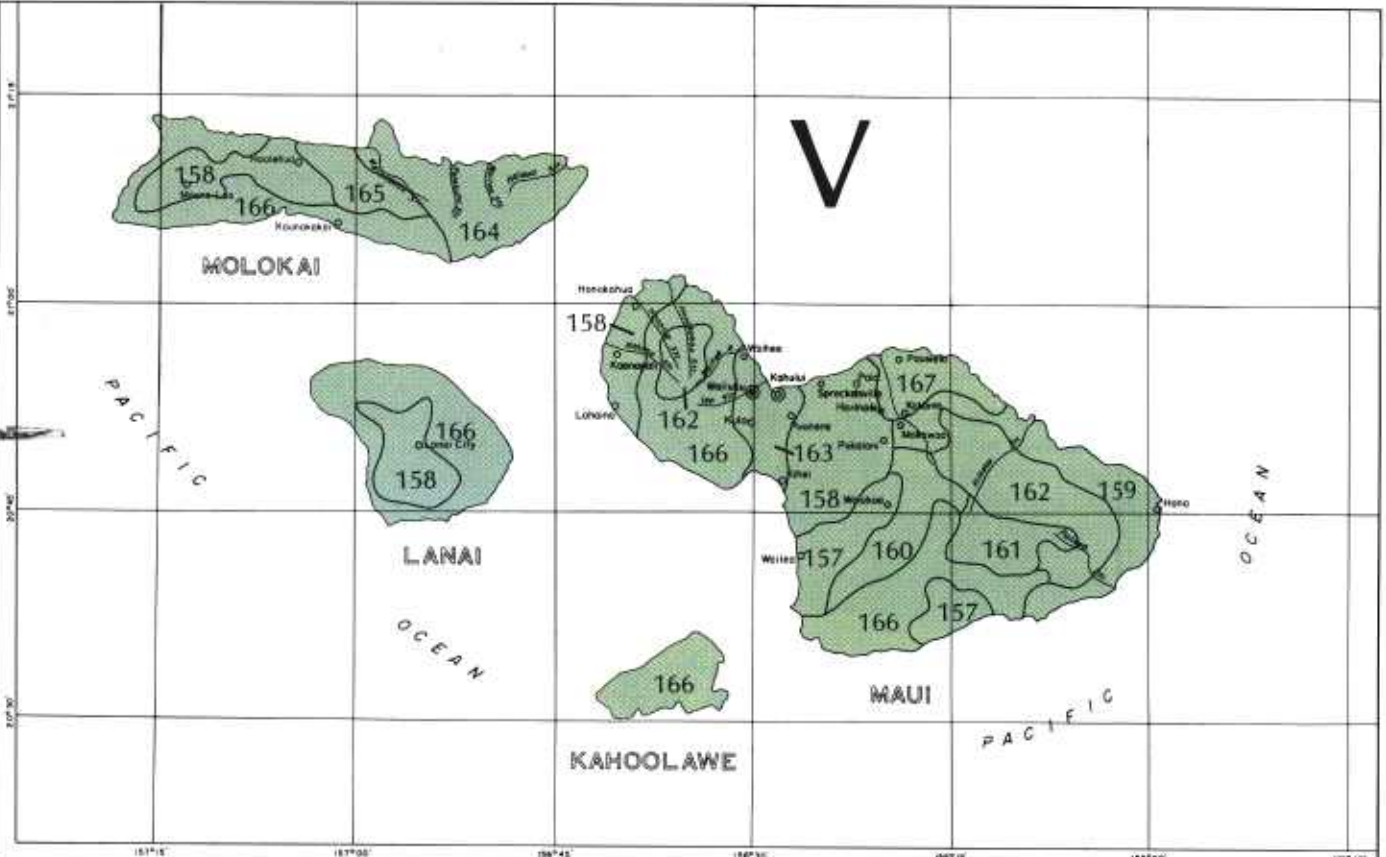
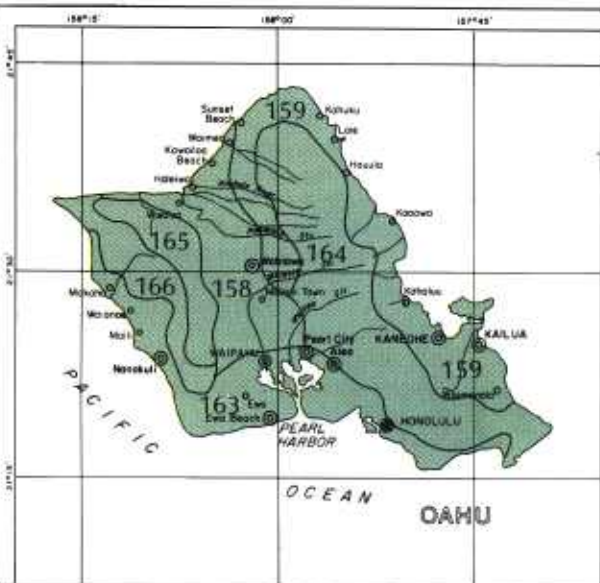
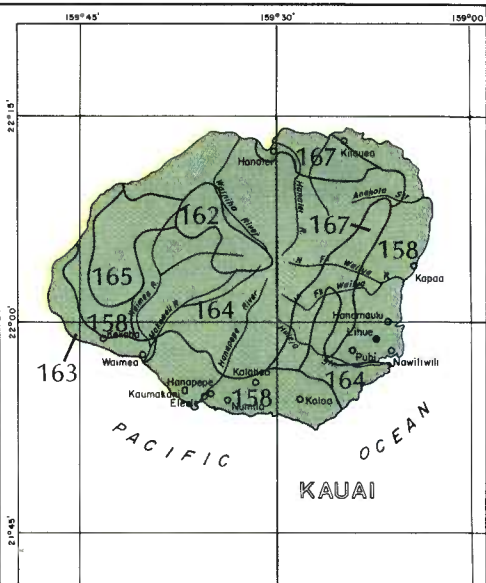
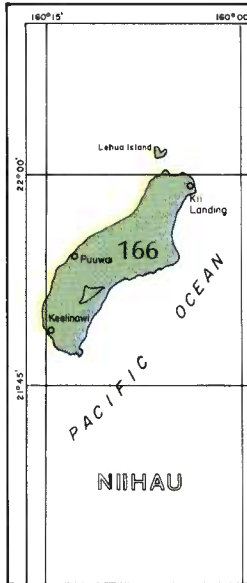


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SOIL CONSERVATION SERVICE



USGS Notation: Atlas 1:1,000,000 Albers Equal-Area projection (1967) used as source for base map and adopted for SCS use



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